Appendix A. Methodology Details

This appendix gives greater details on the methods used to classify imagery, assess the accuracy of the classification, delineate watersheds, calculate the reported landscape metrics, and analyze the data.

Image Classification

The land cover classifications for this study were produced using a modified version of the binary change mask technique (Yuan et al., 1998). Land cover data sets for the Catskill/Delaware watersheds were produced for four time periods:

1. mid-1970s,
2. mid-1980s,
3. late-1980s/early-1990s, and
4. late-1990s.

The land cover classification for the mid-1970s was produced from Landsat MSS images acquired in 1973, 1975, and 1976 (Table A-1). The MSS images acquired in the 1970s contained severe banding and/or line dropouts in band 1. Therefore, the bands 2 (red), 3 (mid-infrared), and 4 (mid-infrared) from one leaf-on and one leaf-off scene were combined into a six-band multi-date mid-1970s image. Since the 1975 image contained clouds, the final classified image also contained a "cloud" category. This cloud class was used as a mask to create another 6-band image using bands 2, 3, and 4 of the leaf-off image (1976) and the secondary leaf-on image (1973).

Land cover classification data for the other three time periods were produced using Landsat TM images. Composite images were created for mid-1980s, early-1990s, and late-1990s by combining Landsat TM bands 3 (red), 4 (infrared), and 7 (mid-infrared) from the leaf-off and leaf-on imagery to create a six-band multi-date image for each time period. These bands were chosen because they represent most of the variation within the scene. Then any clouded areas in the image were masked out. A cloud mask was used to create a second 6-band image from bands 3, 4, and 7 of the April 17, 1985, and June 10, 1987 images.

Fifty spectral classes were generated from the six-band multi-date images using unsupervised classification. Using 20 National High Altitude Photography (NHAP) and 21 National Aerial Photography Program (NAPP) photographs distributed throughout the study area as reference, each spectral cluster was compared to the land cover type in the six-band multi-date image. Spectral clusters were tentatively labeled as one of five land cover types or as mixed between two or more land cover types. The five land cover types are (1) water, (2) developed, (3) barren/ski area/transitional, (4) forest/forested wetlands/secondary forest, and (5) agricultural. Pixels that were spectrally confused or mixed between or among land cover types were assigned into land cover types

Table A-1. Images Used in Land Cover Classifications of Catskill/Delaware Watersheds

Classification Time Period	Leaf-Off Image Date	Leaf-On Image Date
Mid-1970s	3/23/1976*	7/7/1973* 8/2/1975*
Mid-1980s	4/17/1985	7/21/1984 6/10/1987
Early-1990s	4/28/1989	6/21/1991
Late-1990s	4/15/1996	7/26/1998

*Landsat MSS Scene. All other scenes are Landsat TM.

using a series of GIS decision rules. GIS data assembled for this land cover classification project include: (1) a 10-m resolution Digital Elevation Model (DEM) resampled to 30- and 60-m resolutions; (2) data derived from the DEMs (i.e., slope, aspect, hillshade); (3) population density; (4) road density; (5) distance from major roads; (6) City Lights data; (7) distance from streams; (8) bedrock geology; (9) surficial geology; (10) soils; and (11) Normalized-Difference Vegetation Index (NDVI).

The remaining confused pixels were resolved interactively by the analyst. In most cases, the analyst compared the confused clusters to the raw satellite image or to aerial photographs and manually assigned the pixels to a land cover type.

Because a spectral signature for barren ground is so difficult to discern in this region, the barren areas were edited manually with the aid of air photo and satellite image interpretation. Ski areas were identified from tourist maps of the region. Because the ski area texture was easy to distinguish in the leaf-off scene, the analyst was able to screen-digitize their boundaries and include them in the classified image. The transitional areas within flood plains were added through use of a flood plain mask. The flood plain mask was created by screen digitizing all areas upstream from the upstream margin of the reservoir that: (1) were in flat areas (slope <5%) and (2) appeared on the images to include braided streams. All confused pixels or forest pixels within the flood plain were defined as transitional. The three classified images for both the mid-1970s and mid-1980s were merged to create a final image for each of these two time periods.

To facilitate post-classification change comparisons between the mid-1970s and the other land cover data sets, the 1980s and 1990s land cover data were resampled to 60-m resolution. Resampling only slightly alters the land cover totals (Table A-2).

Table A-2. Catskill/Delaware Watersheds Land Cover Area (ha) 30-m versus 60-m Resolution

Land Cover	Mid-1970s	Mid-1980s	Late-1980s/Early-1990s	Late-1990s
30 meter				
Water	——-	10,709	10,894	10,819
Developed	——-	1,809	1,826	1,832
Barren	——-	838	722	827
Forest	——-	374,111	381,027	382,904
Agricultural	——-	50,722	43,442	41,064
60 meter				
Water	10,537.92	10,706	10,894	10,820
Developed	1,230.84	1,807	1,826	1,835
Barren	724.32	846	724	834
Forest	374,254.92	374,083	381,027	382,898
Agricultural	51,626.88	50,798	43,447	41,034

Accuracy Assessment

Accuracy assessment points were chosen using a stratified random sample technique (Fitzpatrick-Lins, 1981, Skirvin *et al.*, 2000). The total number of samples was determined using equation 1. This is the minimum number of samples required using binomial probability theory.

$$n = (z/e)^2 * p * q \qquad (1)$$

where:
n = total number of samples
e = allowable error
p = expected accuracy
q = 1 - p
z = standard normal score for the 95% two-tail confidence level (1.96)

In this study, p was 0.75 and e was 0.05, or $n = (1.96/0.05)^2 * 0.75 * 0.25 = 288.12$ (rounded up to 289). These 289 samples were apportioned among the five land cover classifications according to area, but with a minimum of at least 25 samples per class (Table A-3). Because the amount of change in the area was very small, the area proportions for the early 1990s were used for all dates.

Sample points were randomly selected within the correct cover type with one restriction. The sample had to be located in the center of a homogeneous area (defined as a 90-m by 90-m or larger neighborhood) made up of a single land cover type. The same point locations were used for all dates.

Aerial photographs and other available independent imagery was used as reference or “truth” to determine the accuracy of the Landsat classifications. In order to minimize error due to landscape change, the acquisition dates of the reference data were within two years of the acquisition of the Landsat data. The error matrices which follow compare the classifications from the satellite data and the manually interpreted photographs (Tables A-4 to A-7). Reading across the rows shows the number of points in each class according to the satellite classification; reading down the columns shows the number of points in each class according to the photographic interpretation. Values along the diagonal are in agreement, numbers off the diagonal disagree. Producer’s accuracy is a measure of omission error and relates to how well an area can be classified. Producer’s accuracy is the total number of pixels within a class (on the diagonal) correctly identified, divided by the column total or total number of that category. The user’s accuracy is the total number of correct in a class (on the diagonal), divided by the row total or total number classified in the category. User accuracy is a measure of commission and indicates the probability that what is classified in the image is on the ground. Overall accuracy was quite high for all four dates. Two other measures of accuracy conducted on the error matrix data were the Cohen Kappa and Kendall’s Tau-B, which include omission and commission errors (Congalton, 1991).

Table A-3. Calculated and Actual Number of Samples Used in the Accuracy Assessment

Land Cover Class	Calculated number of samples	Actual number of samples
Water	8	25
Developed	1	25
Barren	1	25
Forest	250	250
Agriculture	30	30

Table A-4. Mid-1970s Classification Error Matrix

	Photography					
Satellite	Water	Developed	Barren	Forest	Ag	User Accuracy
Water	25	0	0	0	0	100%
Developed	0	15	0	2	0	88%
Barren	0	0	18	0	5	78%
Forest	0	12	0	234	11	91%
Ag	0	5	0	6	22	67%
Producer Accuracy	100%	47%	100%	97%	58%	

Overall accuracy = 314/355 = 0.8845
Cohen = 0.7614
Kendall's Tau B = 0.6665

Table A-5. Mid-1980s Classification Error Matrix

	Photography					
Satellite	Water	Developed	Barren	Forest	Ag	User Accuracy
Water	25	0	0	0	0	100%
Developed	0	18	1	4	0	78%
Barren	0	0	18	1	4	82%
Forest	0	3	3	235	9	94%
Ag	0	2	0	2	30	88%
Producer Accuracy	100%	78%	82%	97%	70%	

Overall accuracy = 326/355 = 0.9183
Cohen = 0.83502
Kendall's Tau B = 0.7925

Table A-6. Early 1990s Classification Error Matrix (69 missing points due to lack of adequate photography - 9 water, 11 developed, 13 barren, 28 forest, and 8 ag)

	Photography					
Satellite	Water	Developed	Barren	Forest	Ag	User Accuracy
Water	16	0	0	0	0	100%
Developed	0	11	0	3	0	79%
Barren	0	0	11	1	0	92%
Forest	0	5	0	216	1	97%
Ag	0	3	0	0	19	86%
Producer Accuracy	100%	58%	100%	98%	95%	

Overall accuracy = 273/286 = 0.9545
Cohen = 0.8833
Kendall's Tau B = 0.8240

Table A-7. Late 1990s Classification Error Matrix

	Photography					
Satellite	Water	Developed	Barren	Forest	Ag	User Accuracy
Water	25	0	1	0	0	96%
Developed	0	19	0	4	2	76%
Barren	0	0	18	1	4	78%
Forest	0	7	1	240	11	93%
Ag	0	3	0	0	19	86%
Producer Accuracy	100%	66%	90%	98%	53%	

Overall accuracy = 321/355 = 0.9042
Cohen = 0.7986
Kendall's Tau B = 0.7106

Watershed Delineation

The subwatershed boundaries, or the area contributing to the sample point location, were produced using 10-m digital elevation data (U.S. Geological Survey, DEM) and Arc/Info Grid software. Small errors (sinks) in the DEM were filled to ensure a continuous drainage network and flow accumulation, and direction grids were created.

Drainage channels were then generated using cells with flow accumulations over 900 (i.e., cells into which at least 900 other cells or 9 hectares drained). When water sample point coordinates were imprecise, sample points were manually moved to overlay a best approximation of the appropriate drainage channel. This step was necessary to properly generate contributing areas. In most cases, a location description was available and used to move points to their “correct” locations. When that was not possible, points were moved to the closest point on a drainage. Finally, the watershed command in Grid was used to produce contributing areas for each sample point.

Landscape Metrics

The majority of the landscape metrics used in this report were calculated with the Analytical Tools Interface for Landscape Assessments (ATtILA), an ArcView extension developed by the EPA Landscape Ecology Branch. Those not calculated by ATtILA will be noted in the following descriptions. ATtILA is available free of charge by emailing ebert.donald@epa.gov. Using ATtILA requires ArcView software and the Spatial Analyst extension, both are commercial products available from Environmental Systems Research Institute (ESRI; www.esri.com).

Forest, agriculture, urban, and barren land cover.
These landscape metrics were all calculated using overlay techniques. To determine the proportion of land cover in an area (watershed or subwatershed), the boundary for that area was used to clip the data. Recall that the land cover data were in a raster or grid cell format. The clipped boundary was overlaid on the land cover classification, and any cell whose center was within the boundary was included in the analysis for that area. To compute the proportion of land cover, wetlands, for example, the number of wetland cells inside the boundary was divided by the total number of cells inside the boundary minus those cells classified as water. This process was repeated for forest, total agriculture, barren, pasture, crop, and urban land covers.

Human use index.
The calculations for the human use index used the same method as above, but the numerator was changed to include two or more land cover types. For the human use index (U_Index), the metric was calculated by dividing the number of cells with agriculture or urban within a given watershed by that watershed’s total number of non-water land cover cells. For natural vegetation index (N-Index), the numerator was defined as the number of cells within the watershed with forest, wetlands, or barren land cover.

Forest, agriculture, urban, and barren, land cover within 30-, 60-, and 120-m buffer of streams.
First, stream data were converted to a raster format using 30 meter cells so they lined up with the land cover. Then they were buffered on each side by 30, 60, and 120 m (one, two, and four cells). Land cover cells that were inside these expanded areas were then extracted from the initial land cover grid and placed into separate riparian zone land cover grids. Finally the watershed and subwatersheds boundaries were overlaid with the riparian zone land cover data. For each watershed, metrics were calculated as the number of cells of a particular land cover (e.g., wetlands) within that watershed’s particular buffer zone (e.g., 120 meters) divided by the number of nonwater land cover cells within the respective buffer zone.

Human use index within 30-, 60-, and 120 m buffer of streams.
The calculations for the human use index along streams used the same method as for land cover along streams, but the numerator was changed to include two land cover types: agriculture and urban. For each of the riparian buffers, the metric was

calculated by dividing the number of cells with agriculture or urban land cover within a buffer zone for a given watershed by the total number of nonwater land cover cells for that buffer zone.

Agriculture on slopes >5%, >10%, and >15% slope.
A grid of slope measurements was queried to see where slopes were >5%, >10%, and >15%. At these locations, the land cover data were examined and the cells classified as agriculture were extracted into a slope-dependent agriculture land cover grid. Next, the boundary for each watershed and subwatershed was overlaid on this grid and, for each area, the number of cells representing agriculture on slopes >5%, >10%, and >15% was determined. This figure was then divided by the total number of nonwater land cover cells within the boundary to calculate the metric.

Stream length and density.
The streams map was overlaid with the watershed and subwatershed boundaries and the streams were clipped along the boundaries. All stream segments within a given boundary were then measured and summed for the stream length metric. Distances were reported in kilometers. Stream length was then divided by the total area, in square kilometers, of the respective watershed for the stream density metric.

Road length and density.
Road length and density calculations were similar to those of stream length and density. Road length is the total length of roads in kilometers within the watershed while road density is road length divided by the area of the watershed in square kilometers.

Roads crossing streams.
To find where roads crossed streams, the roads map was overlaid with the streams map, and any point where roads and streams intersected was used in the metric. The intersection points were then overlaid with the watershed and subwatershed boundaries and the number of points per area was summed. That figure was then normalized by dividing by the total length of streams in kilometers located within the watershed.

Roads within 60 m of streams.
First the streams were buffered to a distance of 60 m. Next, the roads were clipped by the buffer boundaries and only segments found within the buffer zone were used for the metric. The lengths of these road segments, in kilometers, were summed for each watershed and subwatershed. Lastly, the total length of roads for each particular watershed was standardized by dividing it by that watershed's total length of streams, also in kilometers.

Soil Erodibility, Total Organic Carbon, Soil Clay Content (non-ATtILA).
The tables and soil polygon coverages from the USDA-NRCS SSURGO data base were used to generate an average for each of the soil measurements which were then weighted by percent of the polygon area and upper soil layer depth (see SURRGO instruction manual). The average was then associated to its corresponding soil polygon. The polygon coverages for each soil metric were then converted to a 30-m grid and overlaid with the boundary for each watershed and subwatershed. To compute the soil metrics the sum of cell values inside the watershed and subwatershed boundaries were divided by the total number of cells inside the boundary.

Agriculture on Erodible Soils (non-ATtILA).
A grid of k-factor measurements was queried to see where erodibility was greater than or equal to 0.3. At these locations, the land cover data were examined and the cells classified as agriculture were extracted into an erodible-dependent agriculture land cover grid. Next, the boundary for each watershed and subwatershed was overlaid on this grid and, for each area, the number of cells representing agriculture on erodible soils greater than or equal to 0.3 was determined. This figure was then divided by the total number of nonwater land cover cells within the boundary to calculate the metric.

Agriculture in Watershed Located within the Riparian Zone (non-ATtILA).
The percent of total watershed agriculture located within the riparian zone was determined by taking the

area of riparian agriculture (see above) and dividing it by the area of total agriculture within the watershed.

Statistical Analyses

Time series analysis, ARIMA/SAS program, was used to explore the cyclic behavior of water quality, discharge, and precipitation data. The correlogram is an ARIMA output that shows the behavior of the data with time. Water quality, discharge, and precipitation data were collected by different agencies, at different times and frequencies during the months of this study; therefore monthly averages were generated for each data set for use in the analyses.

The monthly averages for water quality were also used to assess trends in time. When assessing temporal measurements, serial correlation in the errors may occur and effect the standard error of the coefficient. Therefore, autoregression (PROC AUTOREG/SAS), which can account for residual serial correlation, was used to determine trends. The model is described as:

(2) $Y = ß_0 + ß_i x + \varphi_1 R_k$

Where Y is the dependent or predicted value (i.e., total nitrogen), ß and φ are regression coefficients, x is time, R is the residual, and k is the lag time. By using a stepwise selection option to select residuals of any lag that contribute significantly, autoregression can fit the errors to the model. If the lag residuals are independent, they will not be added to the model.

Relationships between landscape metrics and water quality data were explored using a stepwise multiple regression technique (PROC REG/SAS). Regression consists of means of dependent values determined by an independent value (Steel and Torrie, 1980). Multiple regression allows for analysis of the relationship between a dependent variable (i.e., average total nitrogen) and many independent variables (landscape metric percentages). However, in order to conduct such an analysis, data must meet a set of basic assumptions (homogeneity of variances and normal distributions). While there are nonparametric procedures available that do not require meeting the above assumptions, they work best on data sets having a sample size less than 10 and may not extract as much information as a valid parametric data analysis (Steel and Torrie, 1980).

Prior to the regression analyses pairwise correlations were used to detect any high colinearity between the landscape variables. A correlation cutoff value of | 0.85 | was used to determine if the landscape metrics were too closely related. High colinearity causes the coefficient to be unstable within the model, making it unreliable in predicting the contribution of landscape metrics on the water quality parameters. When two landscape metrics were correlated |> 0.85 |, one of the metrics was excluded from the regression analysis. Log-transformed total nitrogen, total phosphorous, and fecal coli data were used to linearize the relationship with landscape metrics. The residuals for the final model were checked for outliers, randomness, and normality. Cook's D test was used to detect outliers. To test model stability a variance inflation factor (VIF) was calculated during the multiple regression analysis. If the VIF exceeds 10, then inclusion of a variable in the final model must be justified.

Results of the regression model are interpreted using the magnitude of their coefficients (ß) and R^2 values, which indicated the contribution of individual landscape metrics in the model to the variation in water quality, and total R^2 values, which give an idea of the ability of the models to explain variation.

Appendix B. Regional Watershed Landscape Metrics

Table B-1. Land Cover/Use (early 1990s) for the EPA Region 2, 8-Digit Watersheds

HUC	N-Index (%)	Forest (%)	Wetland (%)	Urban (%)	Pasture (%)
1100005	76.97	74.06	2.90	2.40	16.52
1100006	82.72	79.18	3.54	13.00	2.01
1100007	22.26	21.43	0.83	69.80	1.09
2010001	80.54	79.23	1.31	2.24	12.14
2010004	90.70	89.57	1.12	1.22	4.03
2010006	82.94	77.80	5.14	1.83	7.75
2020001	98.59	96.95	1.65	0.51	0.20
2020002	97.60	92.89	4.71	0.71	1.05
2020003	64.05	61.38	2.66	6.15	20.96
2020004	62.91	59.52	3.39	6.13	24.91
2020005	77.30	76.75	0.55	1.09	17.08
2020006	73.15	71.30	1.85	8.35	13.38
2020007	71.29	68.70	2.60	4.77	17.78
2020008	70.75	67.56	3.19	11.51	13.79
2030101	69.30	66.28	3.02	24.24	3.83
2030102	25.44	25.10	0.34	66.73	0.51
2030103	51.56	46.45	5.10	42.67	1.87
2030104	27.25	21.85	5.40	60.11	6.49
2030105	46.58	41.04	5.54	22.34	24.11
2030202	28.54	26.57	1.98	58.85	4.14
2040101	82.19	81.86	0.33	0.66	14.62
2040102	93.36	93.16	0.20	0.53	4.34
2040104	91.57	89.60	1.97	2.97	3.06
2040105	57.08	53.12	3.96	8.96	26.30
2040201	39.98	32.37	7.61	13.19	33.48
2040202	44.79	35.53	9.26	29.02	15.93
2040206	48.12	40.72	7.40	6.65	22.77
2040301	73.30	59.58	13.71	12.16	5.60
2040302	66.51	55.56	10.95	9.92	5.74
2050101	70.68	69.79	0.89	1.34	24.04
2050102	70.75	70.06	0.69	1.57	21.95
2050103	72.29	72.12	0.17	3.48	20.38
2050104	68.89	68.77	0.12	0.80	24.55
2050105	68.62	68.34	0.28	2.87	21.42
4120101	52.21	51.90	0.31	3.44	31.23
4120102	56.39	56.09	0.29	1.07	35.85
4120103	42.82	42.60	0.22	12.10	36.20

Blue HUCs = Watersheds surrounding the New York City supply watersheds

Crop (%)	Total Ag. (%)	Barren (%)	U-Index (%)	Road Length (m)	Road Density (km/km^2)
3.42	20.32	0.32	23.03	819,565.78	1.43
0.58	4.26	0.01	17.28	352,689.86	2.82
1.05	6.99	0.95	77.74	6,362,652.39	8.10
4.91	17.18	0.04	19.46	2,597,430.99	1.13
3.68	7.89	0.19	9.30	2,912,002.47	1.05
7.11	15.05	0.18	17.06	2,982,493.97	1.03
0.47	0.68	0.21	1.41	3,188,419.45	0.74
0.56	1.66	0.03	2.40	1,718,242.00	0.63
8.26	29.78	0.02	35.95	5,558,674.05	1.68
5.32	30.90	0.06	37.09	10,072,620.88	1.50
4.22	21.57	0.05	22.70	3,055,777.05	1.27
3.72	18.30	0.20	26.85	11,413,186.04	1.84
5.03	23.83	0.11	28.71	5,826,959.64	1.85
2.34	17.55	0.19	29.25	6,121,631.55	2.52
0.78	6.37	0.10	30.70	6,970,869.21	3.85
0.20	7.81	0.02	74.56	3,549,940.48	9.45
0.42	5.68	0.10	48.44	15,415,997.38	5.24
1.55	12.38	0.27	72.75	8,338,286.06	7.30
4.55	30.84	0.24	53.42	9,555,411.38	3.42
3.47	11.49	1.12	71.46	19,219,451.69	6.89
2.33	17.13	0.01	17.81	3,018,618.96	1.30
1.68	6.11	0.01	6.64	2,403,224.74	1.11
1.70	5.40	0.06	8.43	3,055,590.12	1.52
6.20	33.74	0.23	42.92	6,174,342.61	2.63
10.76	46.49	0.34	60.02	1,940,712.14	3.00
6.22	25.00	1.19	55.21	8,099,793.23	4.42
9.71	44.61	0.62	51.88	5,871,971.23	2.18
2.24	12.79	1.75	26.70	9,501,064.02	3.04
4.10	21.93	1.64	33.49	3,925,393.29	2.52
3.58	27.97	0.01	29.32	7,123,367.50	1.36
5.16	27.57	0.10	29.25	5,779,477.46	1.40
2.78	24.20	0.02	27.71	3,661,074.65	1.56
5.31	30.25	0.06	31.11	2,494,621.01	1.36
6.10	28.47	0.04	31.38	4,464,783.38	1.69
12.19	44.22	0.14	47.79	1,428,990.80	1.80
6.20	42.43	0.12	43.61	1,946,842.95	1.37
6.43	45.02	0.06	57.18	4,750,118.20	2.46

Table B-1 (continued). Land Cover/Use (early 1990s) for the EPA Region 2, 8-Digit Watersheds

HUC	N-Index (%)	Forest (%)	Wetland (%)	Urban (%)	Pasture (%)
4120104	30.50	29.59	0.90	12.42	41.44
4130001	23.73	22.70	1.04	3.92	47.71
4130002	60.23	59.91	0.31	0.89	30.74
4130003	31.88	31.22	0.67	4.82	43.80
4140101	43.78	41.04	2.75	9.57	34.79
4140102	73.08	68.04	5.03	0.84	21.61
4140201	42.60	40.98	1.62	4.16	38.59
4140202	65.65	58.13	7.51	3.74	23.33
4140203	61.65	56.21	5.44	4.93	25.06
4150101	83.42	72.29	11.13	0.88	12.28
4150102	39.14	35.40	3.74	1.41	52.69
4150301	45.60	42.23	3.37	2.43	46.08
4150302	84.03	74.25	9.78	0.43	13.19
4150303	72.09	63.77	8.32	0.47	23.24
4150304	84.75	80.49	4.25	0.87	11.94
4150305	93.89	85.46	8.43	0.63	4.08
4150306	91.36	84.00	7.37	0.21	6.82
4150307	76.58	71.24	5.33	0.67	19.52
5010001	80.41	80.00	0.41	1.03	15.40
5010002	58.28	54.66	3.61	2.26	31.90
5010004	55.64	53.61	2.03	0.55	37.56

Crop (%)	Total Ag. (%)	Barren (%)	U-Index (%)	Road Length (m)	Road Density (km/km^2)
12.62	56.73	0.35	69.50	4,901,419.39	2.57
23.22	72.12	0.23	76.27	4,368,403.88	1.66
7.71	38.87	0.01	39.77	5,055,149.99	1.46
17.58	63.10	0.20	68.12	5,355,459.99	1.89
9.12	46.55	0.09	56.22	4,402,852.02	2.43
4.25	25.99	0.10	26.93	2,959,807.26	1.18
13.26	53.17	0.08	57.40	15,965,159.51	1.78
6.53	30.37	0.25	34.35	5,318,815.68	1.41
7.04	33.36	0.06	38.35	695,004.34	2.01
2.63	15.02	0.68	16.58	4,405,838.34	0.88
6.42	59.45	0.01	60.86	1,115,646.50	1.33
5.39	51.73	0.24	54.40	165,591.55	1.20
1.91	15.16	0.38	15.97	2,191,387.56	0.82
2.80	26.08	1.35	27.91	1,446,399.88	0.98
2.19	14.24	0.14	15.25	1,655,811.15	0.99
1.03	5.20	0.28	6.11	2,466,381.39	0.75
1.28	8.11	0.31	8.64	2,020,860.31	0.93
2.97	22.61	0.14	23.42	2,108,333.08	1.03
2.75	18.51	0.05	19.59	4,150,871.85	1.56
6.61	39.41	0.05	41.72	2,848,904.92	1.46
5.77	43.81	0.00	44.36	353,299.53	1.22

Table B-2. Riparian Buffer (60m) Land Cover/Use (early 1990s) for the EPA Region 2, 8-Digit Watersheds

HUC	Stream Length (m)	Stream Density (km/km2)	N-Index (%)	Forest (%)	Wetlands (%)
1100005	402,588.43	0.71	77.25	68.67	8.58
1100006	139,828.37	1.13	87.38	79.23	8.15
1100007	220,821.48	0.32	40.95	30.13	7.78
2010001	1,076,898.25	0.47	81.34	75.46	5.88
2010004	1,172,848.61	0.42	89.43	86.03	3.40
2010006	1,569,841.24	0.54	86.91	74.26	12.66
2020001	2,530,329.75	0.59	97.51	91.02	6.49
2020002	1,902,101.64	0.70	96.83	81.84	14.99
2020003	1,574,346.74	0.48	68.19	60.20	8.00
2020004	5,454,127.58	0.81	71.04	64.21	6.84
2020005	1,473,805.06	0.61	68.63	67.31	1.32
2020006	3,335,542.50	0.54	74.27	68.52	5.75
2020007	1,684,439.24	0.32	71.43	66.95	4.48
2020008	1,809,946.15	0.74	74.26	65.60	8.66
2030101	1,585,754.50	0.47	40.31	35.95	4.34
2030102	262,010.21	0.71	40.08	38.79	1.27
2030103	1,156,958.88	0.41	60.64	55.21	5.43
2030104	950,255.82	0.93	48.08	27.46	20.59
2030105	2,421,022.98	0.87	63.64	47.15	16.50
2030202	980,786.39	0.37	51.34	31.55	13.76
2040101	1,358,908.20	0.59	76.26	75.40	0.85
2040102	979,925.94	0.45	87.04	86.31	0.73
2040104	1,145,453.46	0.34	87.33	80.41	6.92
2040105	2,063,088.82	0.88	65.81	55.07	10.74
2040201	712,134.67	1.10	66.11	44.46	21.65
2040202	2,246,462.23	1.23	70.63	41.99	28.63
2040206	4,986,824.18	1.85	83.49	37.59	45.86
2040301	5,563,562.45	1.78	86.98	48.45	38.51
2040302	2,155,799.29	1.39	89.72	45.33	44.39
2050101	3,667,424.33	0.70	66.73	64.53	2.20
2050102	3,074,667.92	0.74	71.00	69.19	1.81
2050103	2,024,411.84	0.86	74.28	73.71	0.56
2050104	754,002.36	0.41	72.07	71.71	0.36
2050105	1,663,626.49	0.63	74.34	73.51	0.83
4120101	434,306.00	0.55	62.30	61.88	0.42
4120102	947,026.94	0.67	60.13	59.26	0.86

Blue HUCs = Watersheds surrounding the New York City supply watersheds

Urban (%)	Pasture (%)	Crop (%)	Total Ag. (%)	Barren (%)	U-Index (%)
4.05	13.91	3.67	17.57	0.18	21.80
10.63	0.72	0.90	1.62	0.00	12.25
53.37	0.98	4.05	5.04	3.68	59.05
3.79	8.55	5.63	14.18	0.08	18.05
2.85	3.03	4.46	7.48	0.24	10.57
2.44	4.62	5.89	10.51	0.13	13.09
0.93	0.25	1.03	1.28	0.28	2.49
1.39	0.80	0.97	1.76	0.01	3.17
6.76	15.92	9.10	25.02	0.03	31.81
4.22	20.53	4.16	24.69	0.05	28.96
2.51	21.85	6.96	28.80	0.06	31.37
7.92	12.63	4.98	17.61	0.15	25.68
2.49	20.36	5.01	25.37	0.02	27.88
10.65	11.17	3.76	14.93	0.16	25.74
30.63	1.47	2.21	3.68	0.03	34.33
54.05	0.63	5.24	5.87	0.02	59.92
35.47	0.55	1.57	2.12	0.01	37.60
41.69	5.33	3.28	8.61	0.07	50.35
15.08	18.16	2.86	21.02	0.26	36.36
42.78	1.89	3.89	5.78	6.13	48.66
1.82	18.23	3.57	21.80	0.01	23.63
2.19	7.81	2.96	10.77	0.00	12.96
2.48	6.65	2.97	9.62	0.03	12.14
9.60	20.11	3.25	23.36	0.19	33.15
7.51	22.03	3.95	25.98	0.16	33.64
17.11	8.44	2.37	10.81	0.76	28.69
3.06	9.00	3.97	12.97	0.51	16.50
8.55	2.29	1.28	3.57	0.92	13.02
4.17	1.83	1.94	3.77	2.34	10.28
2.37	26.50	4.40	30.89	0.00	33.27
2.26	20.87	5.74	26.62	0.13	29.00
3.63	18.49	3.60	22.08	0.01	25.72
2.15	18.60	7.07	25.66	0.11	27.93
3.76	16.89	4.99	21.88	0.03	25.66
4.31	24.08	8.94	33.01	0.38	37.70
1.68	31.62	6.52	38.14	0.06	39.87

Table B-2 (continued). Riparian Buffer (60m) Land Cover/Use (early 1990s) for the EPA Region 2, 8-Digit Watersheds

HUC	Stream Length (m)	Stream Density (km/km2)	N-Index (%)	Forest (%)	Wetlands (%)
4120103	1,616,498.49	0.84	53.78	53.38	0.40
4120104	1,569,370.17	0.83	39.82	38.25	1.57
4130001	2,438,611.62	0.93	30.87	28.96	1.91
4130002	2,324,509.38	0.67	58.50	57.14	1.36
4130003	2,510,899.36	0.88	43.69	42.10	1.59
4140101	1,467,445.66	0.82	53.87	48.22	5.64
4140102	2,443,500.89	0.98	79.55	69.82	9.40
4140201	7,555,960.27	0.84	54.07	50.36	3.71
4140202	3,163,041.44	0.84	74.26	59.60	14.65
4140203	289,294.53	0.84	72.10	59.83	12.27
4150101	4,330,523.65	0.86	84.42	64.44	19.99
4150102	623,373.50	0.71	48.45	39.30	9.15
4150301	92,056.46	0.77	49.13	39.21	9.92
4150302	2,457,122.13	0.92	86.17	66.82	19.34
4150303	1,361,924.01	0.92	80.23	59.70	20.54
4150304	141,852.20	0.08	78.09	65.00	13.08
4150305	2,759,552.41	0.84	94.30	74.43	19.87
4150306	2,098,149.72	0.97	91.86	76.18	15.68
4150307	1,617,949.30	0.80	77.18	69.57	7.61
5010001	1,564,807.07	0.59	68.27	66.84	1.43
5010002	1,048,013.86	0.54	62.63	52.21	10.42
5010004	256.24	0.00	45.19	41.35	3.85

Urban (%)	Pasture (%)	Crop (%)	Total Ag. (%)	Barren (%)	U-Index (%)
7.71	32.47	6.01	38.48	0.02	46.22
5.99	41.83	12.05	53.87	0.31	60.18
3.59	46.66	18.54	65.20	0.34	69.13
1.67	30.50	9.32	39.82	0.01	41.50
3.27	39.80	13.19	52.99	0.06	56.31
7.47	29.10	9.54	38.65	0.02	46.13
0.91	16.80	2.73	19.54	0.33	20.45
3.73	32.04	10.10	42.14	0.06	45.93
3.49	17.76	4.40	22.16	0.09	25.74
3.62	17.94	6.20	24.14	0.15	27.90
0.89	11.98	2.41	14.39	0.30	15.58
2.28	43.02	6.24	49.26	0.01	51.55
3.78	39.10	8.00	47.10	0.00	50.87
0.37	11.71	1.44	13.15	0.31	13.83
0.53	17.27	1.34	18.61	0.63	19.77
1.40	17.61	1.90	19.51	1.00	21.91
0.73	3.77	0.90	4.68	0.29	5.70
0.26	6.68	0.96	7.65	0.24	8.14
1.01	19.49	2.29	21.78	0.03	22.82
1.75	24.67	5.27	29.94	0.04	31.73
3.39	26.41	7.55	33.96	0.03	37.37
0.00	48.08	6.73	54.81	0.00	54.81

Appendix C. Catskill/Delaware Subwatershed Landscape Metrics

Table C-1. Land Cover/Use (late 1990s) for NYCDEP Subwatersheds

Watershed	Subwatershes	Forest (%)	Urban (%)
Ashokan	Ashokan Reservoir	97.08	1.22
Ashokan	Beaver Kill	98.25	0.26
Ashokan	Birch Creek	96.58	0.29
Ashokan	Broadstreet Hollow	99.77	0.08
Ashokan	Bush Kill_Ash	99.14	0.07
Ashokan	Bushnellsville Creek	99.49	0.05
Ashokan	Esopus Creek	96.46	1.92
Ashokan	Esopus Creek Headwaters	99.54	0.05
Ashokan	Little Beaverkill	97.99	0.11
Ashokan	Peck Hollow	99.94	0.03
Ashokan	Stony Clove Creek	98.98	0.70
Ashokan	Woodland Creek	99.26	0.41
Cannonsville	Bagley Brook	88.35	0.34
Cannonsville	Beers Brook	95.58	0.01
Cannonsville	Betty Brook	80.70	0.12
Cannonsville	Cannonsville Reservoir	95.55	0.01
Cannonsville	Chamberlain Brook	96.97	0.00
Cannonsville	Chase Brook	99.61	0.00
Cannonsville	Dry Brook_Can	93.60	0.00
Cannonsville	Dryden Brook	90.06	0.00
Cannonsville	East Brook	75.24	0.56
Cannonsville	Elk Creek	72.55	0.18
Cannonsville	Falls Creek	72.34	0.15
Cannonsville	Fish Brook	99.68	0.00
Cannonsville	Johnny Brook	95.60	0.00
Cannonsville	Kidd Brook	77.46	0.00
Cannonsville	Lake Brook	74.49	0.04
Cannonsville	Little Delaware River	81.76	0.05
Cannonsville	Loomis Brook	80.57	0.01
Cannonsville	Peaks Brook	83.17	0.03
Cannonsville	Pines Brook	79.02	0.15
Cannonsville	Platner Brook	71.75	0.04
Cannonsville	Rose Brook	83.35	0.02
Cannonsville	Sherruck Brook	95.34	0.01
Cannonsville	Steele Brook	63.99	1.53
Cannonsville	Third Brook	70.54	2.31
Cannonsville	Town Brook	72.51	0.50
Cannonsville	Trout Creek_Can	80.83	0.33
Cannonsville	Wakeman Brook	96.34	0.00
Cannonsville	West Branch Delaware Headwaters	70.74	3.24
Cannonsville	West Branch Delaware River	75.50	1.42
Cannonsville	West Brook	75.34	1.36
Cannonsville	Wright Brook	75.26	0.24

Agriculture (%)	Barren (%)	U_index (%)	Ag. Slope 3% (%)	Ag. Slope 5% (%)	Ag. Slope 10% (%)	Ag. Slope 15% (%)
1.70	0.00	2.92	0.68	0.40	0.04	3.70
1.49	0.00	1.75	0.45	0.31	0.03	1.87
1.78	1.35	3.42	1.50	1.16	0.11	6.17
0.15	0.00	0.23	0.11	0.06	0.00	2.56
0.80	0.00	0.86	0.25	0.20	0.06	7.74
0.46	0.00	0.51	0.32	0.23	0.05	10.20
1.62	0.00	3.54	0.43	0.19	0.03	2.00
0.41	0.00	0.46	0.17	0.10	0.03	6.52
1.90	0.00	2.01	1.06	0.61	0.03	1.32
0.03	0.00	0.06	0.03	0.03	0.00	0.00
0.32	0.00	1.02	0.15	0.06	0.00	1.33
0.32	0.00	0.74	0.32	0.27	0.10	31.94
11.30	0.00	11.65	10.51	8.90	0.29	2.61
2.38	2.03	4.42	2.09	1.99	0.39	16.38
19.19	0.00	19.30	15.92	10.88	0.14	0.74
1.55	2.88	4.45	0.74	0.59	0.04	3.15
3.03	0.00	3.03	2.89	2.35	0.13	4.15
0.29	0.10	0.39	0.18	0.13	0.00	0.00
6.40	0.00	6.40	6.18	4.97	0.09	1.36
9.94	0.00	9.94	9.02	7.12	0.21	2.08
24.21	0.00	24.76	21.27	16.75	0.36	1.47
27.27	0.00	27.45	23.37	18.09	1.15	4.22
27.51	0.00	27.66	20.94	13.29	0.38	1.37
0.32	0.00	0.32	0.31	0.29	0.06	18.18
4.40	0.00	4.40	4.24	3.67	0.14	3.15
22.54	0.00	22.54	18.98	12.69	0.16	0.71
25.48	0.00	25.51	21.36	15.43	0.21	0.84
18.16	0.03	18.24	16.53	14.10	0.57	3.14
19.42	0.00	19.43	17.56	13.79	0.16	0.84
16.80	0.00	16.83	15.63	12.91	0.43	2.56
20.83	0.00	20.98	19.80	16.37	0.19	0.93
28.21	0.00	28.25	25.69	20.71	0.56	1.99
16.63	0.00	16.65	15.33	13.23	0.49	2.97
4.65	0.00	4.66	4.35	3.90	0.12	2.58
34.48	0.00	36.01	31.60	24.37	0.21	0.60
27.15	0.00	29.46	25.35	21.61	0.86	3.16
26.99	0.00	27.49	24.24	18.39	0.19	0.72
18.84	0.00	19.17	15.55	12.76	0.39	2.08
3.66	0.00	3.66	3.54	3.04	0.52	14.24
25.58	0.44	29.26	21.61	15.39	0.19	0.74
22.47	0.61	24.50	15.40	12.11	0.61	2.74
23.31	0.00	24.66	21.07	17.50	0.27	1.15
24.50	0.00	24.74	21.17	17.37	0.64	2.62

Table C-1(continued). Land Cover/Use (late 1990s) for NYCDEP Subwatersheds

Watershed	Subwatershed	Forest (%)	Urban (%)
Neversink	East Branch Neversink River	99.27	0.02
Neversink	Neversink Reservoir	93.76	0.17
Neversink	Neversink River	97.97	0.37
Neversink	West Branch Neversink River	99.34	0.02
Pepacton	Batavia Kill_Pep	87.92	0.07
Pepacton	Bush Kill_Pep	92.52	0.34
Pepacton	Dry Brook_Pep	96.85	0.01
Pepacton	East Branch Delaware Headwaters	87.72	0.40
Pepacton	East Branch Delaware River	88.30	1.57
Pepacton	Fall Clove (Brydon Lake)	87.91	0.00
Pepacton	Mill Brook	95.19	0.00
Pepacton	Pepacton Reservoir	94.85	0.00
Pepacton	Platte Kill	86.36	0.14
Pepacton	Terry Clove (Bryden Hill)	85.18	0.03
Pepacton	Tremper Kill	83.25	0.11
Rondout	Chestnut Creek	88.56	0.82
Rondout	Rondout Creek	98.76	0.03
Rondout	Rondout Reservoir	96.56	0.02
Rondout	Sugarloaf Brook	97.47	0.00
Rondout	Trout Creek_Ron	98.81	0.16
Schoharie	Batavia Kill Headwaters	94.80	0.50
Schoharie	Batavia Kill_Sch	89.36	0.97
Schoharie	Bear Kill	77.30	0.41
Schoharie	East Kill	95.49	0.05
Schoharie	Huntersfield Creek	89.10	0.70
Schoharie	Johnson Hollow Brook	82.59	0.10
Schoharie	Little West Kill	88.23	0.00
Schoharie	Manor Kill	88.06	0.10
Schoharie	Mitchell Hollow	90.26	0.53
Schoharie	North Settlement	89.28	0.03
Schoharie	Schoharie Creek	86.28	0.31
Schoharie	Schoharie Creek Headwaters	95.78	1.03
Schoharie	Schoharie Reservoir	87.71	0.10
Schoharie	Silver Lake	97.78	0.07
Schoharie	Sutton Hollow	85.51	0.09
Schoharie	West Kill	96.90	0.14

Agriculture (%)	Barren (%)	U_index (%)	Ag. Slope 3% (%)	Ag. Slope 5% (%)	Ag. Slope 10% (%)	Ag. Slope 15% (%)
0.72	0.00	0.73	0.38	0.22	0.02	2.28
5.78	0.29	6.24	4.18	2.52	0.04	0.72
1.66	0.00	2.03	0.75	0.56	0.01	0.49
0.51	0.13	0.66	0.28	0.19	0.04	8.23
12.01	0.00	12.08	10.36	8.26	0.18	1.50
7.08	0.05	7.48	6.35	5.00	0.15	2.16
3.13	0.01	3.15	2.87	2.55	0.15	4.90
11.71	0.17	12.28	10.16	8.20	0.25	2.16
9.59	0.55	11.70	7.46	5.99	0.18	1.88
12.09	0.00	12.09	10.92	9.55	0.46	3.79
4.78	0.03	4.81	4.41	3.92	0.19	3.96
5.10	0.05	5.15	4.34	3.75	0.11	2.44
13.48	0.03	13.64	12.00	10.10	0.29	2.14
14.79	0.00	14.82	13.18	11.28	0.16	1.06
16.43	0.20	16.75	14.87	12.81	0.52	3.17
10.62	0.00	11.44	9.23	7.02	0.29	2.75
1.21	0.00	1.24	0.98	0.87	0.16	13.60
3.42	0.00	3.44	2.46	1.86	0.06	2.16
2.53	0.00	2.53	2.45	2.19	0.38	15.09
1.04	0.00	1.19	0.98	0.74	0.08	7.97
4.69	0.00	5.20	3.09	1.70	0.03	0.74
8.92	0.74	10.64	5.58	3.31	0.11	1.21
21.90	0.40	22.70	18.13	13.04	0.24	1.09
4.35	0.00	4.40	2.72	1.46	0.08	1.77
10.20	0.00	10.90	8.54	5.91	0.08	0.78
17.31	0.00	17.41	15.05	10.45	0.15	0.85
11.77	0.00	11.77	10.84	9.12	0.72	6.12
11.85	0.00	11.95	8.50	5.28	0.08	0.67
9.21	0.01	9.74	6.92	3.60	0.03	0.30
10.69	0.00	10.72	8.46	4.99	0.01	0.08
13.42	0.00	13.72	9.40	6.00	0.11	0.85
2.20	0.99	4.22	1.36	0.84	0.05	2.44
10.48	1.71	12.29	5.82	2.97	0.03	0.35
2.15	0.00	2.22	1.67	0.81	0.03	1.24
14.39	0.00	14.49	12.67	10.47	0.85	5.89
2.96	0.00	3.10	2.07	1.42	0.05	1.65

Table C-2. Land Cover/Use (late 1990s) for NYCDEP Subwatershed

Watershed	Subwatershed	Stream Length (m)	Stream Density (km/km^2)
Ashokan	Ashokan Reservoir	236,472.49	2.07
Ashokan	Beaver Kill	87,682.90	1.36
Ashokan	Birch Creek	43,566.26	1.33
Ashokan	Broadstreet Hollow	32,903.30	1.37
Ashokan	Bush Kill_Ash	68,945.73	1.35
Ashokan	Bushnellsville Creek	36,037.53	1.25
Ashokan	Esopus Creek	145,232.58	1.93
Ashokan	Esopus Creek Headwaters	124,789.41	1.62
Ashokan	Little Beaverkill	86,289.58	2.00
Ashokan	Peck Hollow	18,180.59	1.40
Ashokan	Stony Clove Creek	112,696.97	1.35
Ashokan	Woodland Creek	72,092.69	1.36
Cannonsville	Bagley Brook	59,966.30	1.49
Cannonsville	Beers Brook	20,802.59	1.18
Cannonsville	Betty Brook	45,258.23	1.92
Cannonsville	Cannonsville Reservoir	129,582.55	1.56
Cannonsville	Chamberlain Brook	5,016.57	0.87
Cannonsville	Chase Brook	17,305.40	1.40
Cannonsville	Dry Brook_Can	12,665.03	1.11
Cannonsville	Dryden Brook	29,032.21	1.17
Cannonsville	East Brook	105,940.01	1.64
Cannonsville	Elk Creek	60,715.53	1.53
Cannonsville	Falls Creek	35,698.30	1.77
Cannonsville	Fish Brook	5,552.47	0.90
Cannonsville	Johnny Brook	12,903.40	1.53
Cannonsville	Kidd Brook	18,519.02	1.37
Cannonsville	Lake Brook	32,235.66	1.80
Cannonsville	Little Delaware River	185,751.76	1.37
Cannonsville	Loomis Brook	47,632.98	1.48
Cannonsville	Peaks Brook	29,547.02	1.47
Cannonsville	Pines Brook	19,683.96	1.45
Cannonsville	Platner Brook	63,192.03	1.75
Cannonsville	Rose Brook	54,493.07	1.42
Cannonsville	Sherruck Brook	19,466.33	1.36
Cannonsville	Steele Brook	22,822.39	1.30
Cannonsville	Third Brook	22,234.98	1.55
Cannonsville	Town Brook	55,254.10	1.33
Cannonsville	Trout Creek_Can	95,303.20	1.72
Cannonsville	Wakeman Brook	11,327.33	1.40
Cannonsville	West Branch Delaware Headwaters	90,718.00	2.25
Cannonsville	West Branch Delaware River	416,590.83	1.80
Cannonsville	West Brook	104,496.50	1.79
Cannonsville	Wright Brook	55,917.49	1.78

Road Length (m)	Road Density (km/km²)	Xing Density #/km²	Xing Count #	Avg K Factor	Ag. Erod.Soil (%)
117,848.79	1.03	0.49	117.00	0.13	0.09
48,606.89	0.75	0.68	60.00	0.15	1.05
47,737.76	1.46	1.40	61.00	0.12	0.11
7,683.27	0.32	0.76	25.00	0.11	0.00
24,162.24	0.47	0.38	26.00	0.08	0.00
10,982.76	0.38	0.58	21.00	0.12	0.00
78,080.36	1.03	0.88	128.00	0.18	0.67
33,330.21	0.43	0.54	68.00	0.10	0.53
42,379.49	0.98	0.67	58.00	0.14	0.50
2,677.97	0.21	0.39	7.00	0.10	0.00
57,041.55	0.68	0.77	87.00	0.13	0.06
23,109.41	0.43	0.57	41.00	0.12	0.14
47,882.64	1.19	0.60	36.00	0.17	0.07
15,210.95	0.86	0.96	20.00	0.13	0.04
27,901.75	1.18	0.49	22.00	0.18	0.02
78,563.26	0.94	0.32	42.00	0.17	2.92
3,582.07	0.62	0.60	3.00	0.15	0.00
8,784.48	0.71	0.64	11.00	0.10	0.02
10,280.64	0.90	1.11	14.00	0.16	0.09
21,516.45	0.87	0.76	22.00	0.18	0.05
71,313.12	1.10	0.66	70.00	0.19	1.75
42,989.34	1.08	0.59	36.00	0.19	0.04
27,472.42	1.37	1.04	37.00	0.21	0.03
7,532.16	1.21	1.08	6.00	0.11	0.00
7,646.26	0.91	0.54	7.00	0.17	0.02
12,198.37	0.90	0.43	8.00	0.19	0.08
23,256.23	1.30	0.56	18.00	0.20	0.12
159,981.51	1.18	0.94	174.00	0.17	1.06
33,591.61	1.04	0.69	33.00	0.20	0.30
24,196.36	1.21	1.32	39.00	0.18	0.00
13,315.06	0.98	0.66	13.00	0.18	0.72
39,199.48	1.08	0.90	57.00	0.19	1.67
33,675.80	0.88	0.68	37.00	0.16	1.00
13,361.88	0.93	0.46	9.00	0.18	0.32
24,450.21	1.40	1.45	33.00	0.19	0.00
21,990.07	1.54	0.81	18.00	0.20	1.62
49,778.22	1.19	0.89	49.00	0.19	1.83
65,114.57	1.18	0.70	67.00	0.21	1.71
8,885.15	1.10	1.50	17.00	0.13	0.01
72,722.98	1.81	1.18	107.00	0.19	0.34
298,500.62	1.29	0.68	282.00	0.18	23.63
77,464.70	1.33	0.53	55.00	0.19	0.66
38,240.43	1.22	0.80	45.00	0.18	0.34

Table C-2 (continued). Land Cover/Use (late 1990s) for NYCDEP Subwatershed

Watershed	Subwatershed	Stream Length (m)	Stream Density (km/km^2)
Neversink	East Branch Neversink River	108,378.99	1.52
Neversink	Neversink Reservoir	130,633.17	2.31
Neversink	Neversink River	45,441.25	2.04
Neversink	West Branch Neversink River	165,942.92	1.88
Pepacton	Batavia Kill_Pep	74,385.65	1.49
Pepacton	Bush Kill_Pep	180,148.23	1.47
Pepacton	Dry Brook_Pep	133,710.32	1.52
Pepacton	East Branch Delaware Headwaters	220,033.86	1.71
Pepacton	East Branch Delaware River	121,440.47	1.74
Pepacton	Fall Clove (Brydon Lake)	39,362.33	1.36
Pepacton	Mill Brook	96,061.28	1.46
Pepacton	Pepacton Reservoir	265,614.93	1.40
Pepacton	Platte Kill	132,276.77	1.44
Pepacton	Terry Clove (Bryden Hill)	52,400.40	1.34
Pepacton	Tremper Kill	120,691.35	1.39
Rondout	Chestnut Creek	105,188.13	1.92
Rondout	Rondout Creek	153,335.83	1.49
Rondout	Rondout Reservoir	78,387.51	1.67
Rondout	Sugarloaf Brook	30,189.48	1.45
Rondout	Trout Creek_Ron	41,233.63	1.89
Schoharie	Batavia Kill Headwaters	66,358.29	1.83
Schoharie	Batavia Kill_Sch	149,826.80	1.89
Schoharie	Bear Kill	119,202.62	1.78
Schoharie	East Kill	198,895.30	2.12
Schoharie	Huntersfield Creek	41,975.89	2.05
Schoharie	Johnson Hollow Brook	18,349.53	1.36
Schoharie	Little West Kill	25,857.43	1.22
Schoharie	Manor Kill	211,693.52	2.37
Schoharie	Mitchell Hollow	60,260.81	2.68
Schoharie	North Settlement	39,450.17	1.93
Schoharie	Schoharie Creek	138,926.22	2.07
Schoharie	Schoharie Creek Headwaters	286,894.52	2.01
Schoharie	Schoharie Reservoir	74,125.57	2.32
Schoharie	Silver Lake	37,015.50	2.18
Schoharie	Sutton Hollow	20,004.26	1.45
Schoharie	West Kill	125,589.98	1.55

Road Length (m)	Road Density (km/km²)	Xing Density #/km²	Xing Count #	Avg K factor	Ag. Erod.Soil (%)
39,687.72	0.56	0.33	36.00	0.09	0.00
48,652.88	0.86	0.32	42.00	0.21	0.07
21,720.62	0.97	0.46	21.00	0.18	0.11
45,205.66	0.51	0.40	67.00	0.09	0.08
57,495.34	1.15	1.01	75.00	0.16	1.17
134,357.50	1.10	0.87	156.00	0.15	1.86
67,552.57	0.77	0.63	84.00	0.10	0.03
159,140.27	1.24	1.13	248.00	0.16	4.59
97,339.32	1.39	0.77	93.00	0.16	1.97
41,738.32	1.44	0.69	27.00	0.16	0.17
42,148.52	0.64	0.72	69.00	0.13	0.16
187,232.40	0.99	0.67	177.00	0.15	0.14
86,926.08	0.95	0.78	103.00	0.16	0.87
29,223.83	0.75	0.69	36.00	0.17	0.07
128,724.97	1.48	1.06	128.00	0.17	0.33
79,756.08	1.46	0.75	79.00	0.20	0.33
62,597.20	0.61	0.38	58.00	0.10	0.79
54,762.73	1.17	0.66	52.00	0.16	0.67
22,633.55	1.09	0.96	29.00	0.12	0.03
16,932.17	0.77	0.34	14.00	0.12	0.00
21,288.62	0.59	0.51	34.00	0.13	1.05
81,799.98	1.03	0.69	103.00	0.16	12.75
78,009.50	1.17	0.76	90.00	0.18	3.13
81,538.71	0.87	0.50	100.00	0.14	4.91
27,180.78	1.32	0.76	32.00	0.14	0.03
11,217.64	0.83	0.60	11.00	0.18	0.17
15,989.86	0.75	0.58	15.00	0.14	0.00
105,587.30	1.18	0.72	153.00	0.18	6.31
24,416.04	1.08	0.46	28.00	0.16	1.35
18,392.87	0.90	0.58	23.00	0.16	0.14
73,561.68	1.10	0.72	100.00	0.16	0.56
171,184.13	1.20	0.83	237.00	0.14	0.40
34,637.75	1.09	0.63	47.00	0.23	2.24
17,661.51	1.04	0.62	23.00	0.11	0.04
8,398.24	0.61	0.50	10.00	0.16	0.25
32,729.92	0.40	0.54	68.00	0.14	0.77

Table C-3. Land Cover/Use (late 1990s) for NYCDEP Subwatershed Riparian Buffers

Watershed	Subwatershed	Roads (road m/stream m)	Forest (%)	Agriculture (%)
Ashokan	Ashokan Reservoir	0.06	96.67	1.92
Ashokan	Beaver Kill	0.12	95.65	3.62
Ashokan	Birch Creek	0.22	94.17	3.70
Ashokan	Broadstreet Hollow	0.12	99.29	0.41
Ashokan	Bush Kill_Ash	0.07	98.41	1.47
Ashokan	Bushnellsville Creek	0.16	98.59	1.22
Ashokan	Esopus Creek	0.13	92.13	3.63
Ashokan	Esopus Creek Headwaters	0.09	98.60	1.28
Ashokan	Little Beaverkill	0.06	96.04	3.64
Ashokan	Peck Hollow	0.08	99.74	0.12
Ashokan	Stony Clove Creek	0.12	96.98	0.90
Ashokan	Woodland Creek	0.10	98.53	0.30
Cannonsville	Bagley Brook	0.11	80.89	17.81
Cannonsville	Beers Brook	0.28	88.69	5.36
Cannonsville	Betty Brook	0.05	72.58	27.33
Cannonsville	Cannonsville Reservoir	0.07	84.75	4.53
Cannonsville	Chamberlain Brook	0.24	92.32	7.68
Cannonsville	Chase Brook	0.23	98.79	0.78
Cannonsville	Dry Brook_Can	0.38	85.36	14.64
Cannonsville	Dryden Brook	0.17	82.34	17.64
Cannonsville	East Brook	0.13	65.55	33.37
Cannonsville	Elk Creek	0.09	62.35	37.15
Cannonsville	Falls Creek	0.15	67.77	31.89
Cannonsville	Fish Brook	0.20	99.90	0.10
Cannonsville	Johnny Brook	0.04	95.07	4.93
Cannonsville	Kidd Brook	0.07	70.97	29.03
Cannonsville	Lake Brook	0.06	68.55	31.44
Cannonsville	Little Delaware River	0.12	72.47	27.41
Cannonsville	Loomis Brook	0.12	73.39	26.60
Cannonsville	Peaks Brook	0.23	72.90	27.02
Cannonsville	Pines Brook	0.21	67.55	31.85
Cannonsville	Platner Brook	0.16	57.17	42.72
Cannonsville	Rose Brook	0.11	70.96	28.98
Cannonsville	Sherruck Brook	0.12	88.72	11.25
Cannonsville	Steele Brook	0.25	53.48	43.45
Cannonsville	Third Brook	0.09	53.48	41.17
Cannonsville	Town Brook	0.10	59.22	39.60
Cannonsville	Trout Creek_Can	0.10	72.29	26.70
Cannonsville	Wakeman Brook	0.23	91.22	8.78
Cannonsville	West Branch Delaware Headwaters	0.15	69.14	25.40
Cannonsville	West Branch Delaware River	0.11	61.87	34.80
Cannonsville	West Brook	0.09	64.29	33.46
Cannonsville	Wright Brook	0.11	65.13	34.13

60 m			120 m				
Urban (%)	Barren (%)	U-Index (%)	Forest (%)	Agriculture (%)	Urban (%)	Barren (%)	U-Index (%)
1.41	0.00	3.33	96.46	1.99	1.55	0.00	3.54
0.73	0.00	4.35	96.08	3.29	0.63	0.00	3.92
1.01	1.13	5.83	95.07	2.83	0.71	1.39	4.93
0.31	0.00	0.71	99.43	0.37	0.20	0.00	0.57
0.12	0.00	1.59	98.41	1.46	0.13	0.00	1.59
0.19	0.00	1.41	98.74	1.12	0.14	0.00	1.26
4.25	0.00	7.87	92.76	3.28	3.96	0.00	7.24
0.12	0.00	1.40	98.96	0.93	0.11	0.00	1.04
0.32	0.00	3.96	96.38	3.40	0.22	0.00	3.62
0.14	0.00	0.26	99.84	0.07	0.09	0.00	0.16
2.12	0.00	3.02	97.55	0.85	1.60	0.00	2.45
1.17	0.00	1.47	98.50	0.44	1.06	0.00	1.50
1.30	0.00	19.11	80.97	18.08	0.95	0.00	19.03
0.03	5.92	11.31	89.73	5.52	0.01	4.73	10.27
0.09	0.00	27.42	73.23	26.61	0.16	0.00	26.77
0.04	10.69	15.25	88.84	3.84	0.03	7.30	11.16
0.00	0.00	7.68	90.85	9.15	0.00	0.00	9.15
0.00	0.44	1.21	99.26	0.49	0.00	0.25	0.74
0.00	0.00	14.64	86.22	13.78	0.00	0.00	13.78
0.02	0.00	17.66	83.08	16.91	0.01	0.00	16.92
1.08	0.00	34.45	66.95	31.99	1.06	0.00	33.05
0.50	0.00	37.65	62.71	36.86	0.43	0.00	37.29
0.34	0.00	32.23	67.09	32.61	0.30	0.00	32.91
0.00	0.00	0.10	99.83	0.17	0.00	0.00	0.17
0.00	0.00	4.93	93.28	6.72	0.00	0.00	6.72
0.00	0.00	29.03	71.58	28.42	0.00	0.00	28.42
0.02	0.00	31.45	69.59	30.40	0.01	0.00	30.41
0.10	0.01	27.53	72.25	27.66	0.09	0.01	27.75
0.01	0.00	26.61	73.03	26.95	0.02	0.00	26.97
0.08	0.00	27.10	73.91	26.01	0.08	0.00	26.09
0.60	0.00	32.45	69.45	30.18	0.37	0.00	30.55
0.10	0.00	42.83	59.62	40.29	0.09	0.00	40.38
0.06	0.00	29.04	71.04	28.91	0.05	0.00	28.96
0.03	0.00	11.28	90.16	9.82	0.02	0.00	9.84
3.07	0.00	46.52	53.43	43.77	2.80	0.00	46.57
5.34	0.00	46.52	55.77	39.40	4.83	0.00	44.23
1.18	0.00	40.78	59.11	39.76	1.13	0.00	40.89
1.01	0.00	27.71	72.09	27.12	0.80	0.00	27.91
0.00	0.00	8.78	91.86	8.14	0.00	0.00	8.14
5.45	0.02	30.86	66.22	28.48	5.24	0.06	33.78
2.33	1.00	38.13	61.78	34.97	2.40	0.85	38.22
2.26	0.00	35.71	65.82	32.04	2.14	0.00	34.18
0.75	0.00	34.87	64.42	35.04	0.54	0.00	35.58

Table C-3 (continued). Land Cover/Use (late 1990s) for NYCDEP Subwatershed Riparian Buffer

Watershed	Subwatershed	Roads (road m/stream m)	Forest (%)	Agriculture (%)
Neversink	East Branch Neversink River	0.04	98.77	1.18
Neversink	Neversink Reservoir	0.04	95.98	3.10
Neversink	Neversink River	0.05	96.41	2.35
Neversink	West Branch Neversink River	0.06	98.93	0.92
Pepacton	Batavia Kill_Pep	0.13	78.29	21.56
Pepacton	Bush Kill_Pep	0.13	88.90	10.01
Pepacton	Dry Brook_Pep	0.12	94.67	5.31
Pepacton	East Branch Delaware Headwaters	0.17	81.69	17.48
Pepacton	East Branch Delaware River	0.13	82.50	12.25
Pepacton	Fall Clove (Brydon Lake)	0.08	78.26	21.74
Pepacton	Mill Brook	0.11	91.07	8.80
Pepacton	Pepacton Reservoir	0.13	93.16	6.61
Pepacton	Platte Kill	0.12	73.35	26.39
Pepacton	Terry Clove (Bryden Hill)	0.11	67.47	32.50
Pepacton	Tremper Kill	0.17	73.03	26.10
Rondout	Chestnut Creek	0.10	88.28	10.00
Rondout	Rondout Creek	0.08	98.36	1.57
Rondout	Rondout Reservoir	0.06	95.26	4.73
Rondout	Sugarloaf Brook	0.11	96.65	3.35
Rondout	Trout Creek_Ron	0.03	99.22	0.44
Schoharie	Batavia Kill Headwaters	0.09	90.17	8.50
Schoharie	Batavia Kill_Sch	0.08	84.96	12.95
Schoharie	Bear Kill	0.10	70.36	28.64
Schoharie	East Kill	0.06	94.07	5.78
Schoharie	Huntersfield Creek	0.09	82.15	16.54
Schoharie	Johnson Hollow Brook	0.09	67.80	31.73
Schoharie	Little West Kill	0.10	78.48	21.52
Schoharie	Manor Kill	0.09	82.83	16.97
Schoharie	Mitchell Hollow	0.05	85.23	13.73
Schoharie	North Settlement	0.06	86.30	13.68
Schoharie	Schoharie Creek	0.11	82.84	16.48
Schoharie	Schoharie Creek Headwaters	0.10	94.39	3.24
Schoharie	Schoharie Reservoir	0.06	81.42	15.37
Schoharie	Silver Lake	0.07	96.62	3.37
Schoharie	Sutton Hollow	0.07	82.88	16.92
Schoharie	West Kill	0.08	93.89	5.71

60 m			120 m				
Urban (%)	Barren (%)	U-Index (%)	Forest (%)	Agriculture (%)	Urban (%)	Barren (%)	U-Index (%)
0.06	0.00	1.23	98.80	1.17	0.04	0.00	1.20
0.05	0.86	4.02	95.30	4.04	0.14	0.53	4.70
1.24	0.00	3.59	96.59	2.59	0.82	0.00	3.41
0.04	0.11	1.07	98.94	0.86	0.04	0.16	1.06
0.15	0.00	21.71	78.95	20.94	0.10	0.00	21.05
1.00	0.09	11.10	89.10	10.03	0.79	0.08	10.90
0.02	0.00	5.33	94.11	5.87	0.01	0.01	5.89
0.78	0.04	18.31	81.04	18.21	0.69	0.06	18.96
3.12	2.14	17.50	82.33	13.61	2.75	1.31	17.67
0.00	0.00	21.74	78.88	21.12	0.00	0.00	21.12
0.00	0.13	8.93	90.95	8.97	0.00	0.08	9.05
0.01	0.22	6.84	92.59	7.28	0.01	0.13	7.41
0.15	0.11	26.65	74.92	24.92	0.09	0.06	25.08
0.03	0.00	32.53	69.86	30.11	0.03	0.00	30.14
0.48	0.39	26.97	72.92	26.42	0.31	0.36	27.08
1.72	0.00	11.72	87.99	10.61	1.40	0.00	12.01
0.07	0.00	1.64	98.38	1.55	0.06	0.00	1.62
0.01	0.00	4.74	94.90	5.08	0.02	0.00	5.10
0.00	0.00	3.35	96.62	3.38	0.00	0.00	3.38
0.35	0.00	0.78	99.00	0.72	0.28	0.00	1.00
1.33	0.00	9.83	91.30	7.73	0.97	0.00	8.70
1.80	0.29	15.04	84.52	13.52	1.64	0.32	15.48
0.80	0.20	29.64	69.39	29.55	0.72	0.34	30.61
0.10	0.00	5.88	94.08	5.75	0.08	0.00	5.82
1.31	0.00	17.85	82.52	16.24	1.23	0.01	17.48
0.47	0.00	32.21	67.47	32.24	0.28	0.00	32.53
0.00	0.00	21.52	79.77	20.23	0.00	0.00	20.23
0.19	0.00	17.17	83.53	16.31	0.16	0.00	16.47
1.01	0.02	14.77	85.07	14.03	0.89	0.01	14.93
0.03	0.00	13.70	85.66	14.32	0.02	0.00	14.34
0.68	0.00	17.16	81.25	18.17	0.58	0.00	18.75
1.83	0.54	5.61	94.30	3.43	1.62	0.65	5.70
0.11	3.09	18.58	81.57	15.42	0.13	2.88	18.43
0.02	0.00	3.38	96.34	3.54	0.11	0.00	3.66
0.20	0.00	17.12	83.18	16.64	0.19	0.00	16.82
0.41	0.00	6.11	94.43	5.29	0.29	0.00	5.57

Appendix D. Catskill/Delaware Water Quality Site Data

Table D-1. Water Quality Site (NYCDEP) Locations, Universal Transverse Mercator, Zone 18

Site ID	East	North
BK	559828.0000	4654984.0000
BNV	549624.0000	4663216.0000
BRD	552984.0000	4662264.0000
C-38	506530.5669	4679843.2085
C-7	476891.1730	4668863.8763
C-79	505888.0000	4678360.0000
C-8	477144.0000	4667312.0000
CWB	515708.6336	4687062.0322
DCDA	537098.5521	4686561.6626
DCDB	536992.6968	4685034.5965
DLTA	504096.0000	4678048.0000
DLTB	501946.5070	4672671.2628
DTPA	504960.0000	4677832.0000
DTPB	504096.0000	4678048.0000
E1	543008.0000	4664912.0000
E10I	559876.0000	4646540.0000
E12I	563694.0000	4646651.0000
E13I	566337.0000	4647044.0000
E15 ▲	544432.0000	4663072.0000
E16I	560597.0000	4650248.0000
E3 ▲	543690.0000	4663662.0000
E4	545768.0000	4661264.0000
E5	551928.0000	4662648.0000
E6	555432.0000	4658816.0000
E7	557768.0000	4658048.0000
E8I	560360.0000	4651420.0000
EDRA	533114.9768	4675425.8023
EDRB	533404.2858	4674867.9339
FB4	545768.0000	4686144.0000
LBK *	560432.0000	4651912.0000
NEBR	535421.0000	4640609.0000
NK4	526660.0000	4633360.0000
NK6	527456.0000	4630636.0000
NK7A *	534216.0000	4637744.0000
NWBR	535216.0000	4640829.0000
P13	514864.0000	4662852.0000
P21	525168.0000	4664360.0000
P50	533286.6324	4669748.1698
P52	536684.0000	4667360.0000
P60 *	522204.0000	4661456.0000
P7	508264.0000	4664036.0000
P8	509072.0000	4662312.0000
PAKA	536336.0000	4667420.0000
PDRY	531138.5807	4665843.3747
PMSA ▲	528309.3125	4665306.0000
PMSB ▲	528289.0625	4665100.5000
PQTPA	516456.0000	4685984.0000
PQTPB	516124.4594	4686128.7061
PSR	532754.0000	4687688.0000
RD1	540828.0000	4634648.0000
RD4	545384.0000	4630144.0000
RDOA *	542528.0000	4634804.0000
RGA ▲	538132.0000	4632468.0000
RGB ▲	538216.0000	4632444.0000
RK	538048.0000	4632432.0000
S1 ▲	570219.0000	4670748.0000
S10	548000.0000	4683528.0000
S2 ▲	569624.0000	4670552.0000
S3	562456.0000	4673912.0000
S4	551880.0000	4676756.0000
S5I	546408.0000	4685240.0000
S6I	545192.0000	4687216.0000
S7I *	546960.0000	4691880.0000
S8	543192.0000	4689852.0000
S9	543408.0000	4689720.0000
SCL	556540.0000	4659032.0000
SCL-2	558692.0000	4661528.0000
SEK	556288.0000	4676072.0000
SKTPA	523072.5161	4687746.2624
SKTPB	522888.0000	4687744.0000
SWK	550264.0000	4675624.0000
WDBN	486661.0535	4663857.3569
WDHOA	527432.0000	4691048.0000
WDHOB	525854.2826	4690943.4654
WDHOM	526152.0312	4690952.4186
WDL	555240.0000	4658804.0000
WDLFA	496600.0000	4668072.0000
WDLFB	495180.0000	4667036.0000
WDSTA	531480.0000	4696072.0000
WDSTB	530445.7912	4694226.3687
WDSTM	530626.6374	4694248.7434
WSPA ▲ *	488360.0000	4667984.0000
WSPB ▲	488144.0000	4666630.0000

Blue = Regression Sites, Red = Model Validation Sites, * = Temporal Analysis Sites, ▲ = Treatment Plant Monitoring Sites

Table D-2. Waste Treatment Plant Site (NYCDEP) Locations, Universal Transverse Mercator, Zone 18

Waste Treatment Plant Site	East	North
Stamford WWTP	530176.4375	4694662.0000
Golden Acres #3	541752.6133	4693620.6482
Golden Acres #2	541819.3398	4693531.6797
Golden Acres #1	541601.3666	4693295.9128
Rondevous Restaurant	544584.7063	4693191.9704
Village of Hobart PCF	525960.1875	4691003.0000
SEVA Institute #003 (Seasonal)	521385.8438	4689844.0000
SEVA Institute #002 (Seasonal)	521385.8438	4689844.0000
Grand Gorge STP	543299.6875	4689790.0000
South Kortright Center for Boys	522924.3750	4687750.5000
Penn Quality Meats Coop., Inc.	516363.0000	4686133.0000
Thompson House Inc. (Seasonal)	563306.1875	4684079.0000
Frog House Restaurant, The	560306.5625	4683997.0000
Snowtime	561174.1250	4683760.0000
Crystal Pond (Seasonal Limits)	565422.1875	4682566.0000
Mountain View Estates	566674.8500	4678561.6800
Delhi V (Seasonal Limits)	505155.5938	4677788.5000
Roxbury Run Village	534148.8750	4676537.0000
Harriman Lodge (Seasonal)	572548.3125	4675906.5000
Forester Motor Lodge	564769.4375	4673765.5000
Colonel Chair Estates-Block 8 (#002)	563623.5625	4673599.5000
Camp Loyaltown (Seasonal)	564986.9375	4673456.5000
Delaware Boces	475840.0000	4673336.0000
Liftside	565238.5625	4673025.5000
Hunter Highlands WPC	565357.2500	4672693.5000
Whistle Tree Development	566392.1250	4672392.5000
Camp Nubar (Seasonal)	511080.8750	4670944.5000
Tannersville STP	569957.3750	4670883.5000
Latvian Church Camp (Seasonal)	569710.8125	4668260.5000
Elka Park (Seasonal)	569536.7500	4667481.5000
Walton (V) WWTP	488293.8125	4667303.5000
Regis Hotel (Seasonal)	539654.7500	4667283.5000
Camp Timber Lake (Seasonal)	554277.7500	4666270.5000
Belleayre Mtn. Ski Center (#001)	541161.0000	4665415.5000
Margaretville STP	528504.5017	4665120.1691
Belleayre Mtn. Ski Center (#002)	540910.5625	4664426.0000
Pine Hill STP	544289.7500	4663302.5000
Onteora Jr-Sr High School (Seasonal)	560543.2500	4650587.5000
Grahamsville STP	538449.5625	4631957.5000
Camp Tai Chi (Seasonal)	516484.2500	4662472.5000
Maverick Inn	572291.3702	4650220.0711
EG&G Rotran	565977.4165	4648349.2190

Table D-3. Site Locations for Water Quality, Discharge, and Precipitation, Universal Transverse Mercator, Zone 18

Precipitation Sample Sites	East	North
ARKVILLE 2 W	528927.9128	4664055.6651
CLARYVILLE	535657.1646	4640769.9485
DELHI 2 SE	508249.4957	4677324.9605
GRAHAMSVILLE	539016.6823	4633015.5705
LANSING MANOR	543583.9998	4699663.0166
SHOKAN BROWN STA	566307.9964	4644320.7990

Discharge Sample Sites	East	North
01365000	542602.0000	4634887.0000
01350080	548300.0000	4691581.0000
01414500	522256.0000	4661379.0000
01362500	560353.0000	4651393.0000
01435000	533991.0000	4637431.0000
01423000	488397.0938	4668024.0000

Water Quality Sample Sites	East	North
S7I	546960.0000	4691880.0000
WSPA	488360.0000	4667984.0000
P60	522204.0000	4661456.0000
LBK	560432.0000	4651912.0000
NK7A	534216.0000	4637744.0000
RDOA	542528.0000	4634804.0000

Table D-4. Descriptive Statistics for 32 Water Quality Sites in the Catskill/Delaware Watersheds

Site	Year	TN	TP	FC	TN	TP	FC	TN	TP	FC
			Minimum			Maximum			Mean	
		mg/L	ug/L	CFU/100ml	mg/L	ug/L	CFU/100ml	mg/L	ug/L	CFU/100ml
BK	1987-1988		0.00	2.00		35	720		8.92	49.30
	1990-1994	0.05	4.00	2.00	0.84	30	1,700	0.22	10.19	22.32
	1995-1998	0.01	3.00	1.00	0.44	55	880	0.18	11.35	28.38
BNV	1987-1988		0.00	2.00		2500	430		205.54	59.78
	1990-1994	0.16	0.40	1.00	1.62	30	1,200	0.52	13.08	41.26
	1995-1998	0.06	6.00	1.00	0.72	68	320	0.34	16.15	11.08
BRD	1987-1988		0.00	2.00		30	700		12.85	32.68
	1990-1994	0.06	4.00	2.00	1.21	34	380	0.45	13.09	18.04
	1995-1998	0.03	6.00	1.00	0.95	107	228	0.34	23.32	18.34
C-38	1987-1988	0.00	22.60	2.00	0.00	65	240	0.00	41.43	69.91
	1990-1994	0.39	6.00	2.00	1.54	458	1,390	0.80	40.66	76.56
	1995-1998	0.15	7.00	1.00	1.65	287	2,560	0.72	34.61	86.97
C-7	1987-1988		14.40	2.00		73	680		26.11	100.81
	1990-1994	0.35	4.00	2.00	0.87	244	4,100	0.58	21.31	260.31
	1995-1998	0.23	2.00	1.00	1.02	134	3,000	0.56	16.76	323.44
C-79	1987-1988		10.80	4.00		139	490		28.68	99.75
	1990-1994	0.23	7.00	2.00	1.13	385	1,440	0.73	26.24	78.17
	1995-1998	0.11	3.00	1.00	1.41	184	2,900	0.53	19.70	94.89
C-8	1987-1988		10.80	2.00		51	200		19.64	25.77
	1990-1994	0.12	4.00	2.00	0.84	66	1,240	0.49	18.01	42.44
	1995-1998	0.07	2.00	4.00	0.82	59	2,020	0.39	14.39	84.26
E1	1987-1988		5.00	2.00		35	750		13.15	21.29
	1990-1994	0.03	4.00	2.00	0.88	37	350	0.32	13.33	14.66
	1995-1998	0.05	6.00	1.00	0.49	52	396	0.23	15.90	22.04
E10I	1987-1988		0.00	2.00		35	200		8.92	12.64
	1990-1994	0.02	4.00	2.00	0.84	40	660	0.28	9.65	17.99
	1995-1998	0.02	5.00	1.00	0.43	27	216	0.18	10.78	11.09
E12I	1987-1988		0.00	2.00		55	600		13.55	86.32
	1990-1994	0.07	5.00	2.00	0.67	50	9,600	0.29	14.60	252.48
	1995-1998	0.09	6.00	2.00	0.80	153	11,100	0.29	16.94	232.45
FB4	1987-1988		30.00	4.00		75	2,800		55.86	252.78
	1990-1994	0.19	5.00	4.00	1.07	184	6,000	0.65	57.92	297.55
	1995-1998	0.06	19.00	1.00	1.53	462	20,000	0.54	64.94	320.91
LBK	1987-1988		0.00	2.00		35	670		9.92	48.18
	1990-1994	0.02	4.00	2.00	0.47	75	1,100	0.18	12.07	27.83
	1995-1998	0.03	5.00	1.00	0.91	26	1,100	0.18	11.69	27.26

Table D-4 (continued). Descriptive Statistics for 32 Water Quality Sites in the Catskill/Delaware Watersheds

Site	Year	TN	TP	FC	TN	TP	FC	TN	TP	FC
			Minimum			Maximum			Mean	
		mg/L	*u*g/L	CFU/100ml	mg/L	*u*g/L	CFU/100ml	mg/L	*u*g/L	CFU/100ml
NK6	1987-1988		16.40	2.00		59	84		37.33	18.38
	1990-1994	0.60	8.00	1.00	1.11	220	1,500	0.84	25.48	62.52
	1995-1998	0.29	7.00	1.00	1.23	45	2,000	0.67	20.50	76.47
NK7A	1987-1988	11.40	1.00			22	54		14.61	8.46
	1990-1994	0.11	2.00	1.00	1.34	107	130	0.38	7.77	7.25
	1995-1998	0.10	2.00	1.00	0.65	22	194	0.28	4.36	10.08
P-13	1987-1988		10.80	4.00		65	580		22.75	78.32
	1990-1994	0.22	7.00	1.00	1.52	183	890	0.63	21.30	94.59
	1995-1998	0.14	5.00	1.00	1.13	124	2,000	0.49	17.56	141.90
P-21	1987-1988		10.80	2.00		63	740		25.28	91.73
	1990-1994	0.31	5.00	1.00	1.24	126	535	0.68	21.43	62.49
	1995-1998	0.26	4.00	1.00	1.16	118	10,400	0.56	17.97	142.76
P-50	1987-1988		11.40	4.00		46	272		19.17	47.24
	1990-1994	0.09	3.00	2.00	1.06	92	765	0.51	19.34	51.28
	1995-1998	0.06	3.00	1.00	1.00	116	330	0.32	17.43	40.89
P-52	1987-1988		10.80	2.00		26	234		16.76	36.59
	1990-1994	0.04	2.00	1.00	0.63	109	710	0.28	14.12	29.79
	1995-1998	0.05	2.00	1.00	0.63	42	416	0.21	8.42	21.29
P-60	1987-1988		10.60	2.00		27	200		15.02	33.27
	1990-1994	0.19	2.00	1.00	0.95	370	880	0.53	15.08	33.48
	1995-1998	0.07	2.00	1.00	1.19	76	560	0.38	9.33	25.40
P-7	1987-1988		16.40	5.00		79	500		35.68	130.65
	1990-1994	0.40	8.00	2.00	1.26	169	1,640	0.72	27.22	85.60
	1995-1998	0.16	6.00	1.00	1.10	96	1,580	0.60	21.72	110.34
P-8	1987-1988		11.30	2.00		77	288		27.35	70.05
	1990-1994	0.26	5.00	1.00	1.15	111	1,700	0.58	18.52	75.29
	1995-1998	0.07	3.00	1.00	0.95	114	2,000	0.48	17.91	82.88
RD1	1987-1988		10.60	2.00		38	85		18.39	24.16
	1990-1994	0.06	2.00	1.00	0.57	80	760	0.27	15.21	29.38
	1995-1998	0.05	2.00	1.00	0.49	50	400	0.23	11.54	28.12

Table D-4 (continued). Descriptive Statistics for 32 Water Quality Sites in the Catskill/Delaware Watersheds

Site	Year	TN	TP Minimum	FC	TN	TP Maximum	FC	TN	TP Mean	FC
		mg/L	ug/L	CFU/100ml	mg/L	ug/L	CFU/100ml	mg/L	ug/L	CFU/100ml
RD4	1987-1988		10.30	1.00		20	82		14.68	10.76
	1990-1994	0.01	2.00	1.00	0.55	65	280	0.14	9.26	13.28
	1995-1998	0.02	2.00	1.00	0.35	87	580	0.13	7.05	19.90
RDOA	1987-1988		0.00	1.00		27	70		14.47	17.72
	1990-1994	0.12	2.00	1.00	1.28	98	380	0.44	10.21	20.40
	1995-1998	0.06	2.00	1.00	0.68	123	800	0.28	6.44	27.26
RGA	1987-1988		10.60	2.00		27	210		16.15	50.85
	1990-1994	0.21	3.00	2.00	0.68	59	1,000	0.42	12.53	52.87
	1995-1998	0.08	2.00	1.00	0.68	51	1,000	0.36	12.14	77.28
RK	1987-1988		10.80	4.00		35	216		18.01	32.12
	1990-1994	0.28	2.00	2.00	0.66	97	296	0.44	14.76	32.72
	1995-1998	0.17	4.00	1.00	0.74	43	1,000	0.40	12.64	74.98
S1	1987-1988		0.00	2.00		20	1,100		12.07	74.10
	1990-1994	0.18	5.00	2.00	0.80	81	620	0.41	12.50	26.04
	1995-1998	0.09	5.00	1.00	0.84	79	570	0.35	14.77	21.63
S10	1987-1988		11.00	2.00		45	4,500		24.43	193.52
	1990-1994	0.10	5.00	2.00	0.65	159	3,300	0.33	18.30	107.47
	1995-1998	0.03	6.00	1.00	0.88	131	2,750	0.28	23.68	51.19
S6I	1987-1988		16.00	5.00		99	11,000		54.92	424.52
	1990-1994	0.28	13.00	2.00	1.74	121	29,000	1.02	53.34	285.33
	1995-1998	0.30	9.00	1.00	1.85	188	4,000	0.85	45.52	116.77
S7I	1987-1988		10.00	2.00		78	2,400		39.43	220.38
	1990-1994	0.07	4.00	2.00	0.51	100	11,000	0.28	19.53	129.86
	1995-1998	0.03	5.00	1.00	0.61	51	220	0.24	14.25	17.67
WDHOA	1987-1988		28.90	8.00		152	3,250		92.17	498.32
	1990-1994	1.37	35.00	4.00	11.80	590	3,260	2.59	114.21	259.95
	1995-1998	0.92	29.00	1.00	3.23	280	4,000	1.81	86.90	260.23
WDL	1987-1988		0.00	2.00		36	270		13.71	19.70
	1990-1994	0.07	5.00	2.00	1.16	31	780	0.38	11.86	20.44
	1995-1998	0.03	5.00	1.00	0.51	42	142	0.25	14.16	19.26

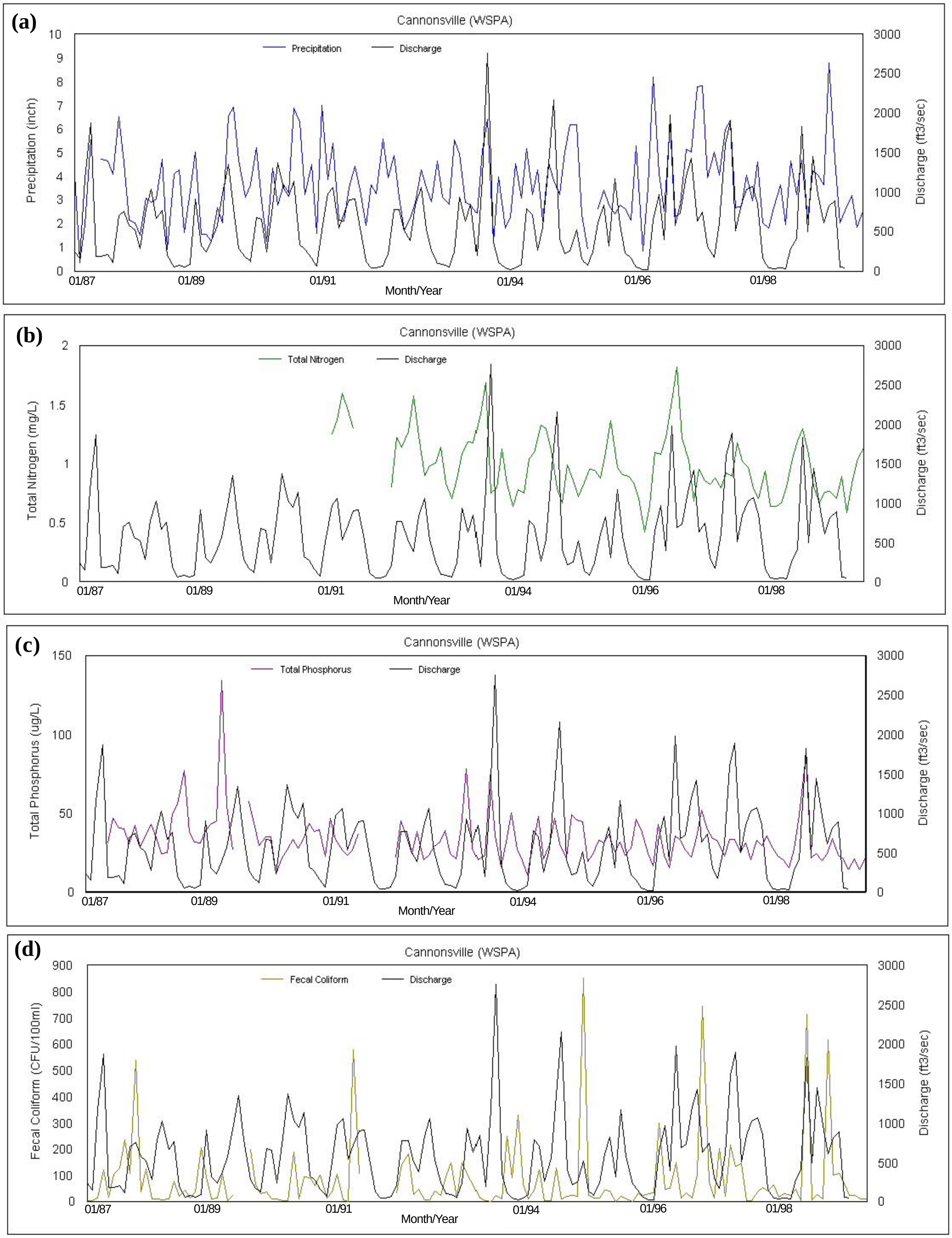


Figure D-1. *Average monthly (1987-1998) discharge and* ***(a)*** *precipitation,* ***(b)*** *total nitrogen,* ***(c)*** *total phosphorus, and* ***(d)*** *fecal coliforms at the Cannonsville water quality trend sites.*

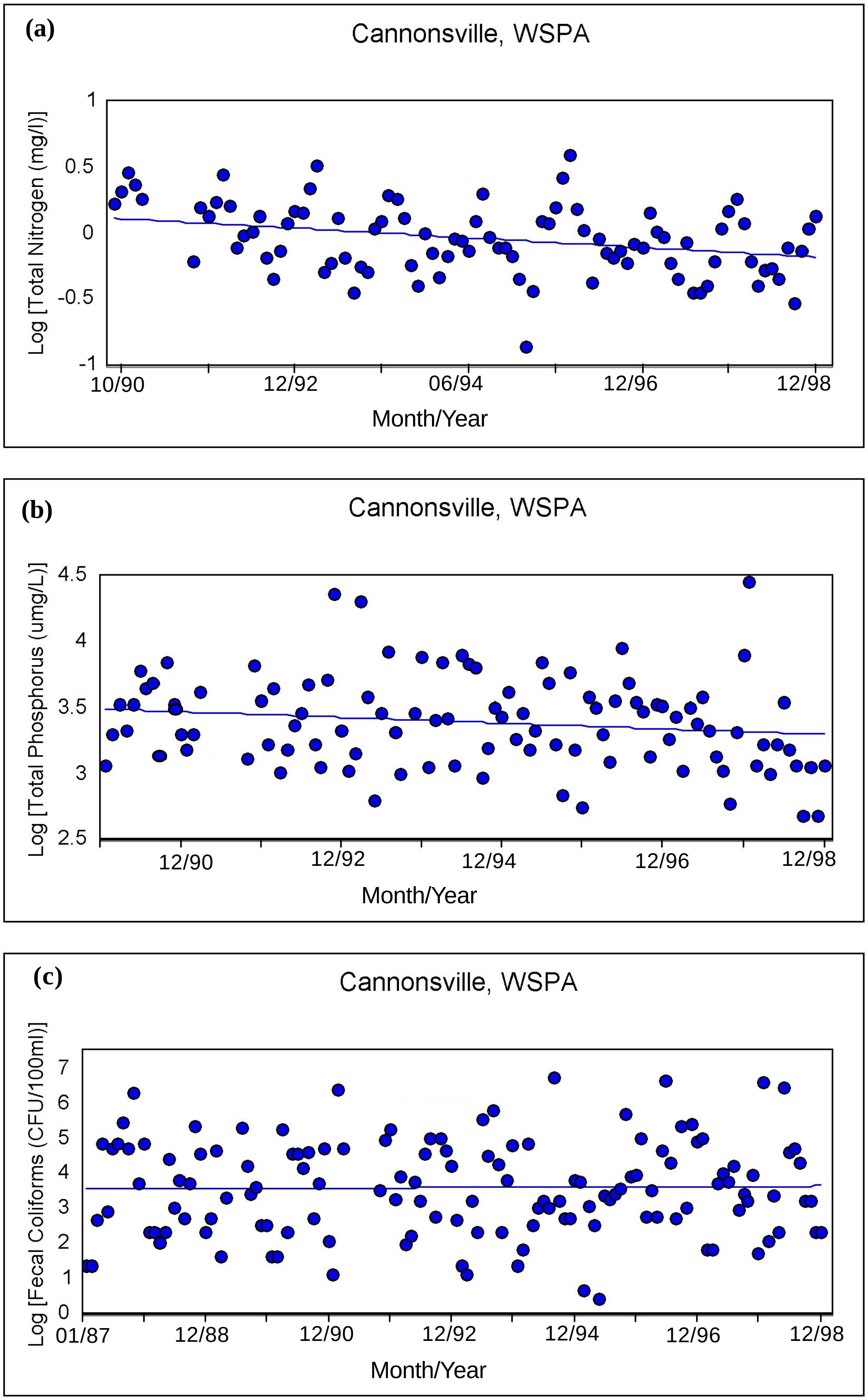


Figure D-2. *Average monthly* ***(a)*** *total nitrogen (1990-1998),* ***(b)*** *total phosphorus (1990-1998), and* ***(c)*** *fecal coliforms (1987-1998) at the Cannonsville water quality trend site. The blue line shows the overall trend with time.*

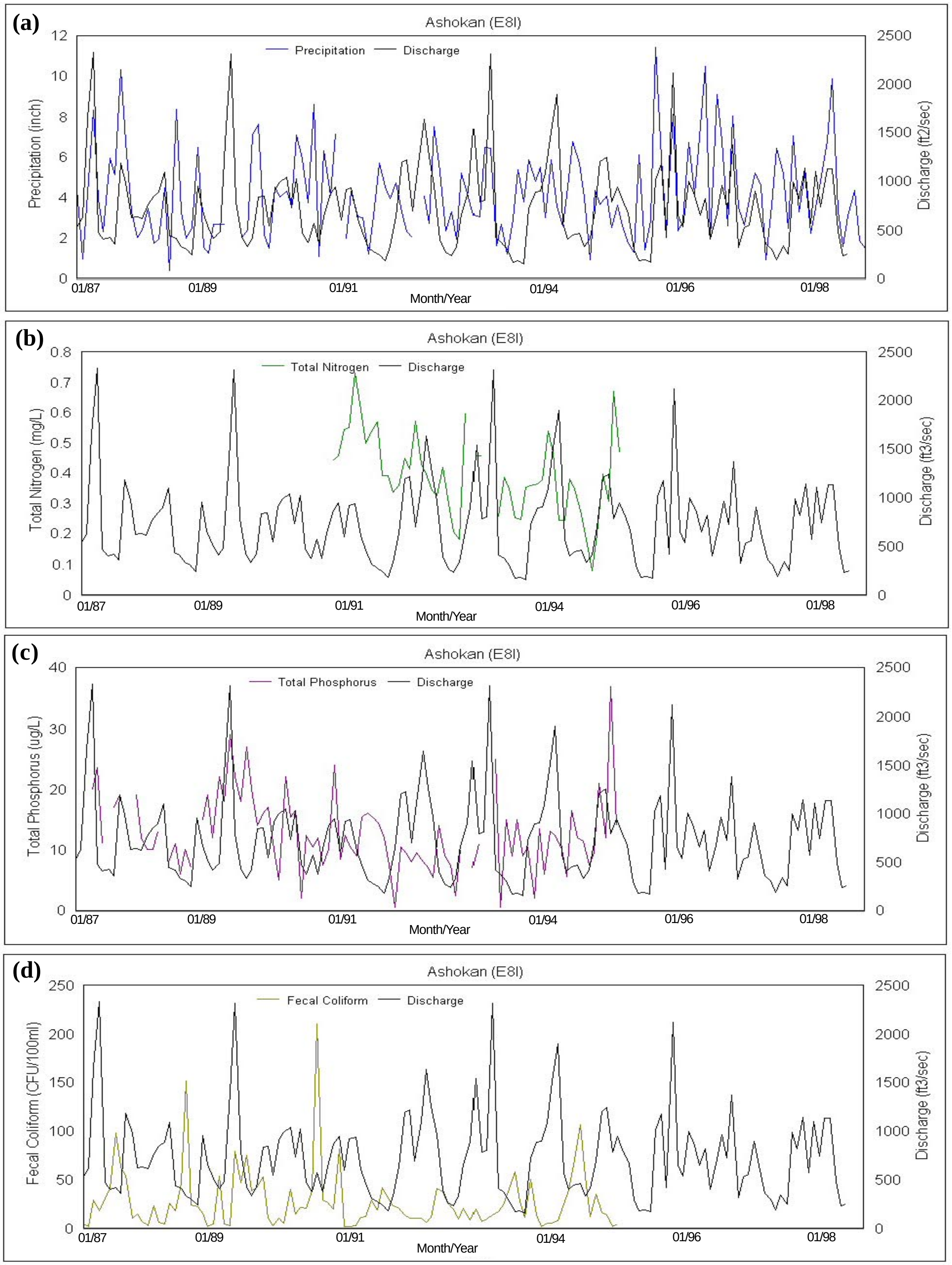


***Figure D-3.** Average monthly (1987-1998) discharge and **(a)** precipitation, **(b)** total nitrogen, **(c)** total phosphorus, and **(d)** fecal coliforms at the Ashokan water quality trend sites.*

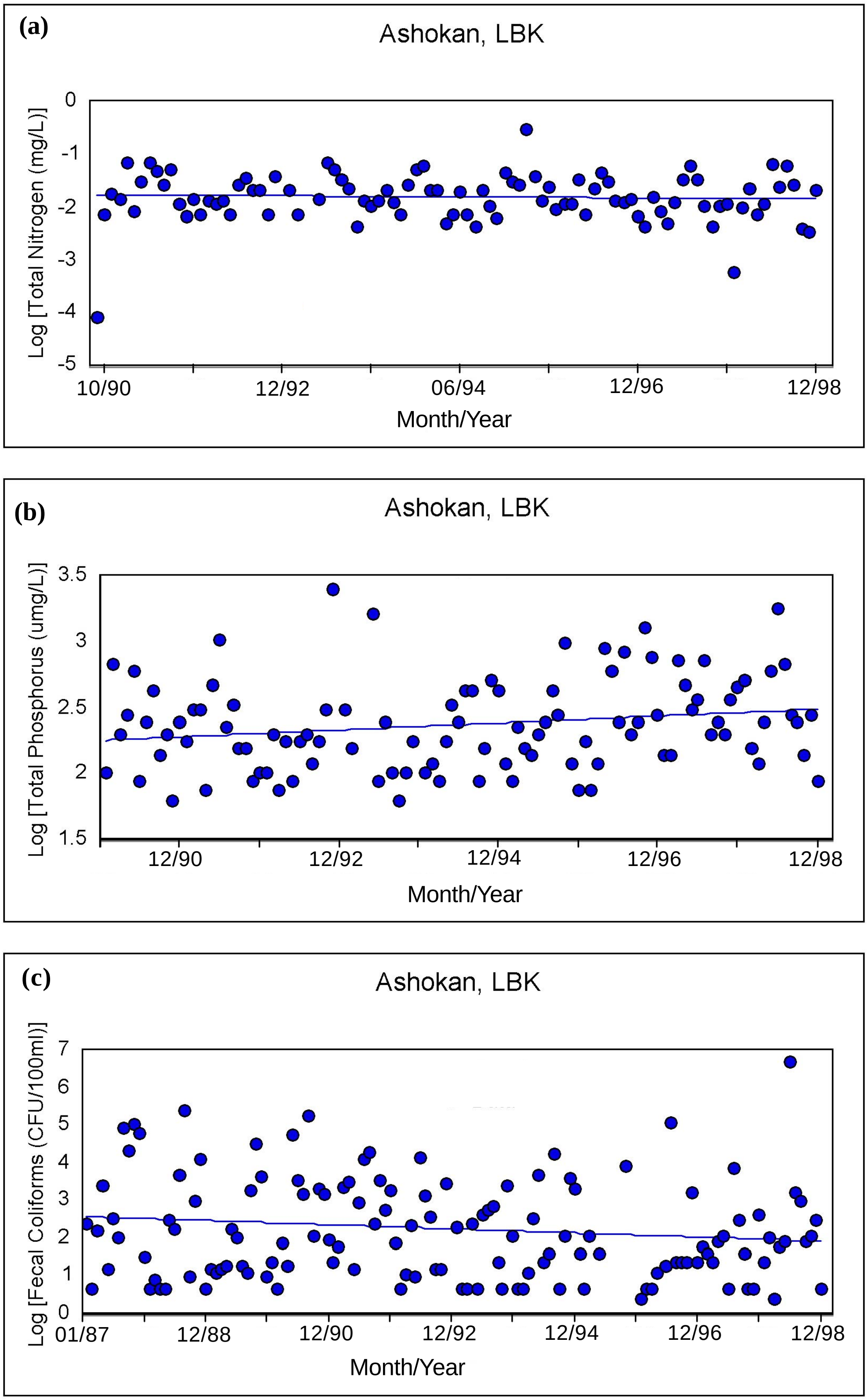


***Figure D-4.** Average monthly **(a)** total nitrogen (1990-1998), **(b)** total phosphorus (1990-1998), and **(c)** fecal coliforms (1987-1998) at the Ashokan water quality trend site. The blue line shows the overall trend with time.*

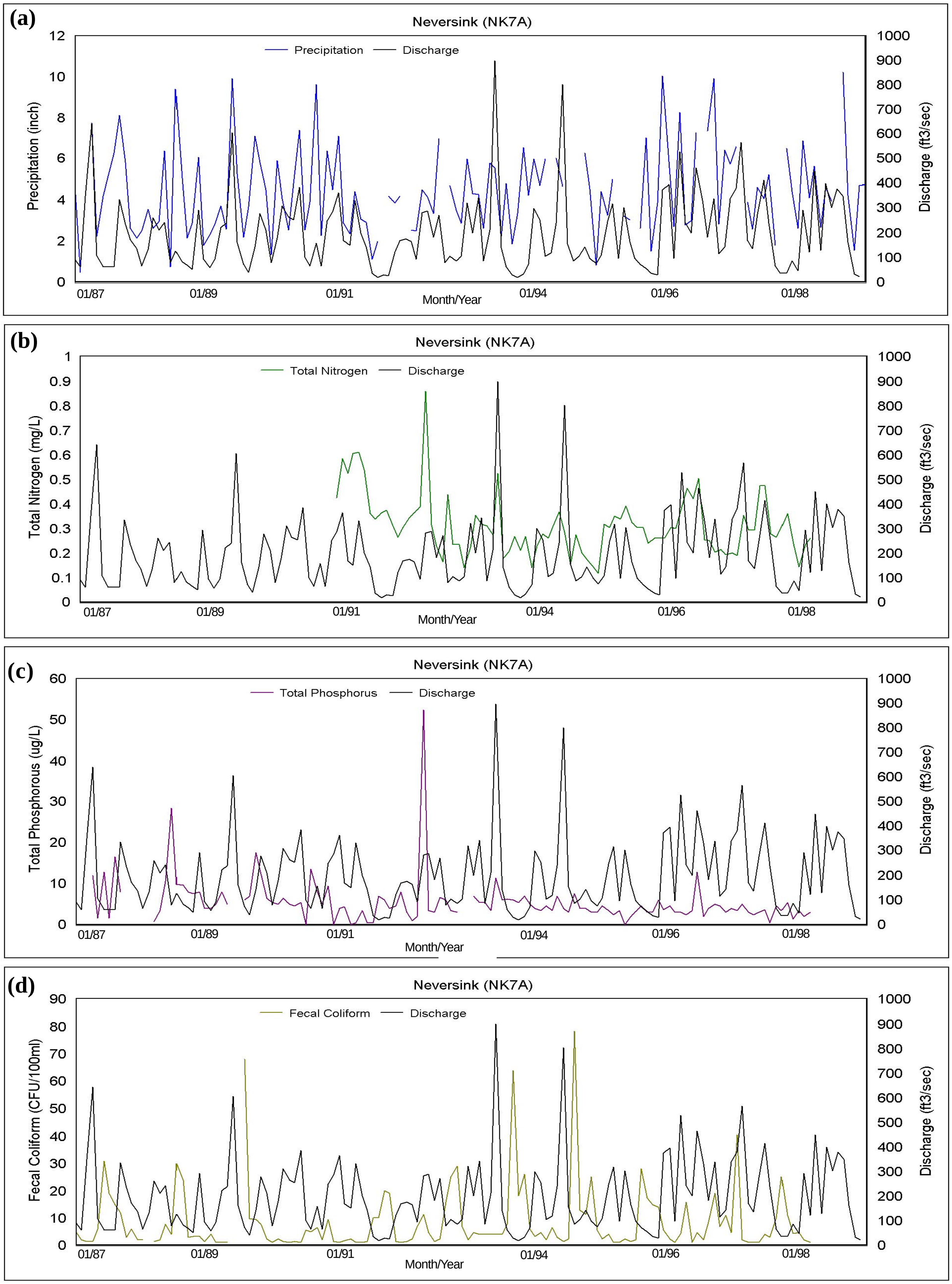


Figure D-5. *Average monthly (1987-1998) discharge and **(a)** precipitation, **(b)** total nitrogen, **(c)** total phosphorus, and **(d)** fecal coliforms at the Neversink water quality trend sites.*

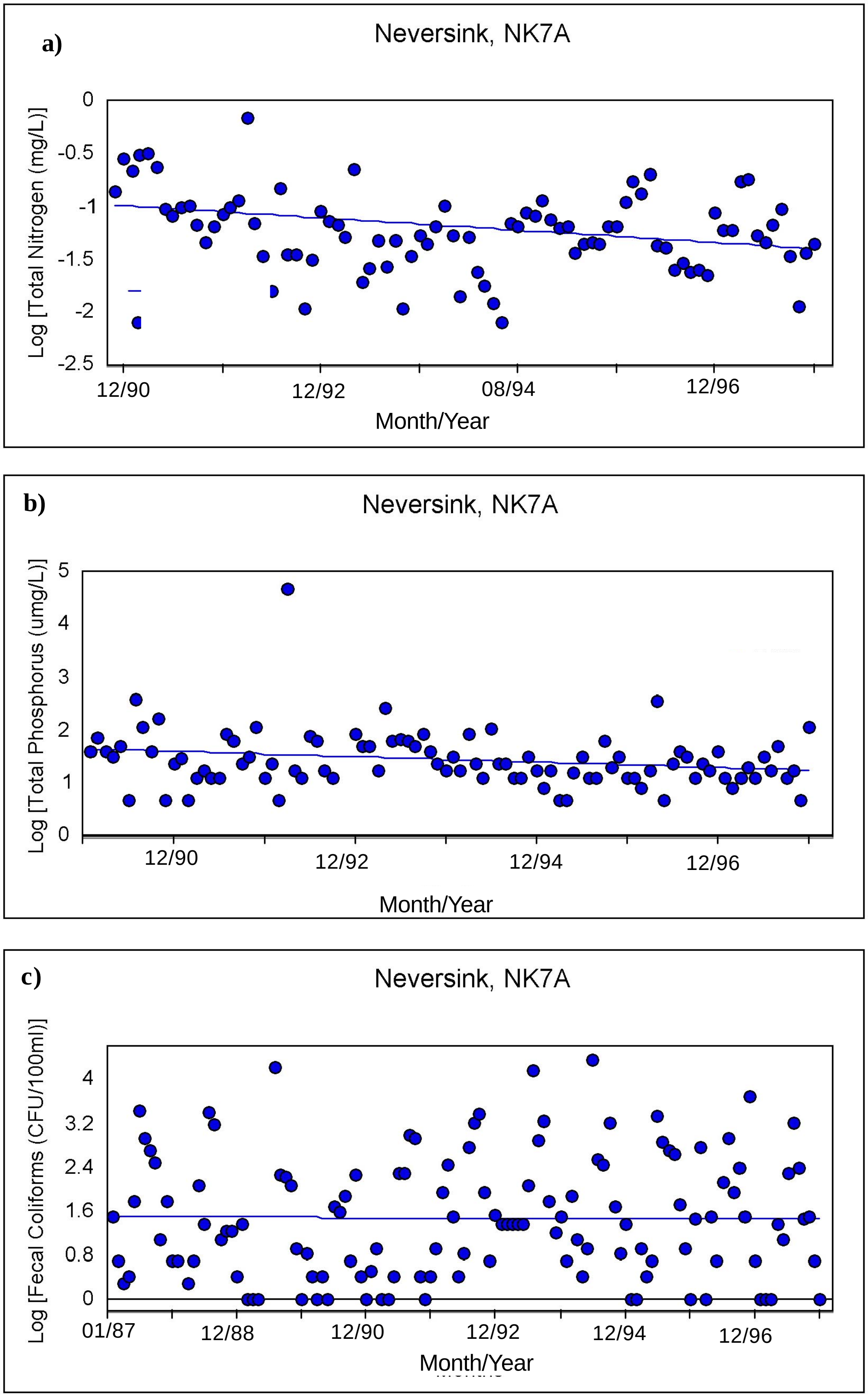


Figure D-6. *Average monthly **(a)** total nitrogen (1990-1998), **(b)** total phosphorus (1990-1998), and **(c)** fecal coliforms (1987-1998) at the Neversink water quality trend site. The blue line shows the overall trend with time.*

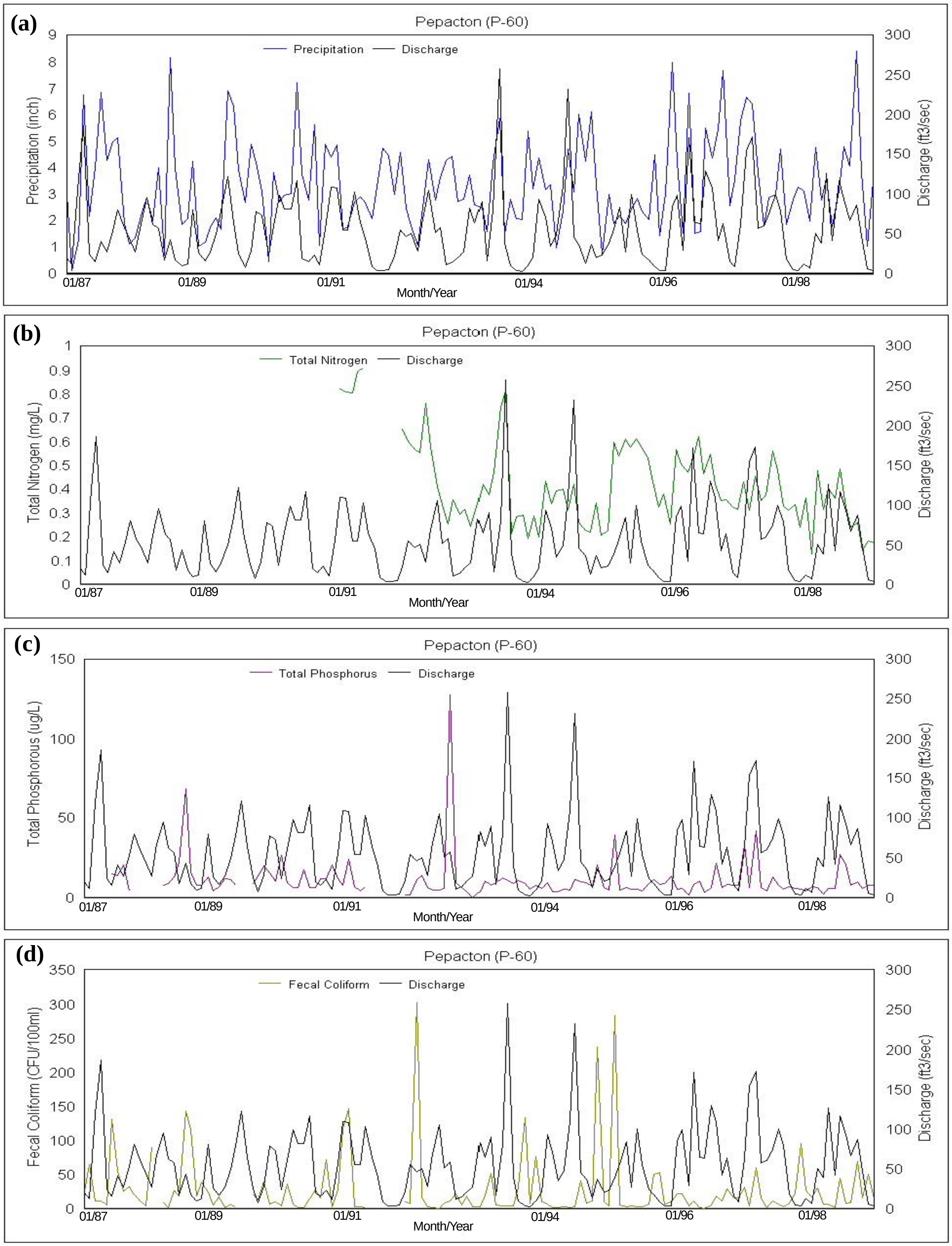


Figure D-7. *Average monthly (1987-1998) discharge and **(a)** precipitation, **(b)** total nitrogen, **(c)** total phosphorus, and **(d)** fecal coliforms at the Pepacton water quality trend sites.*

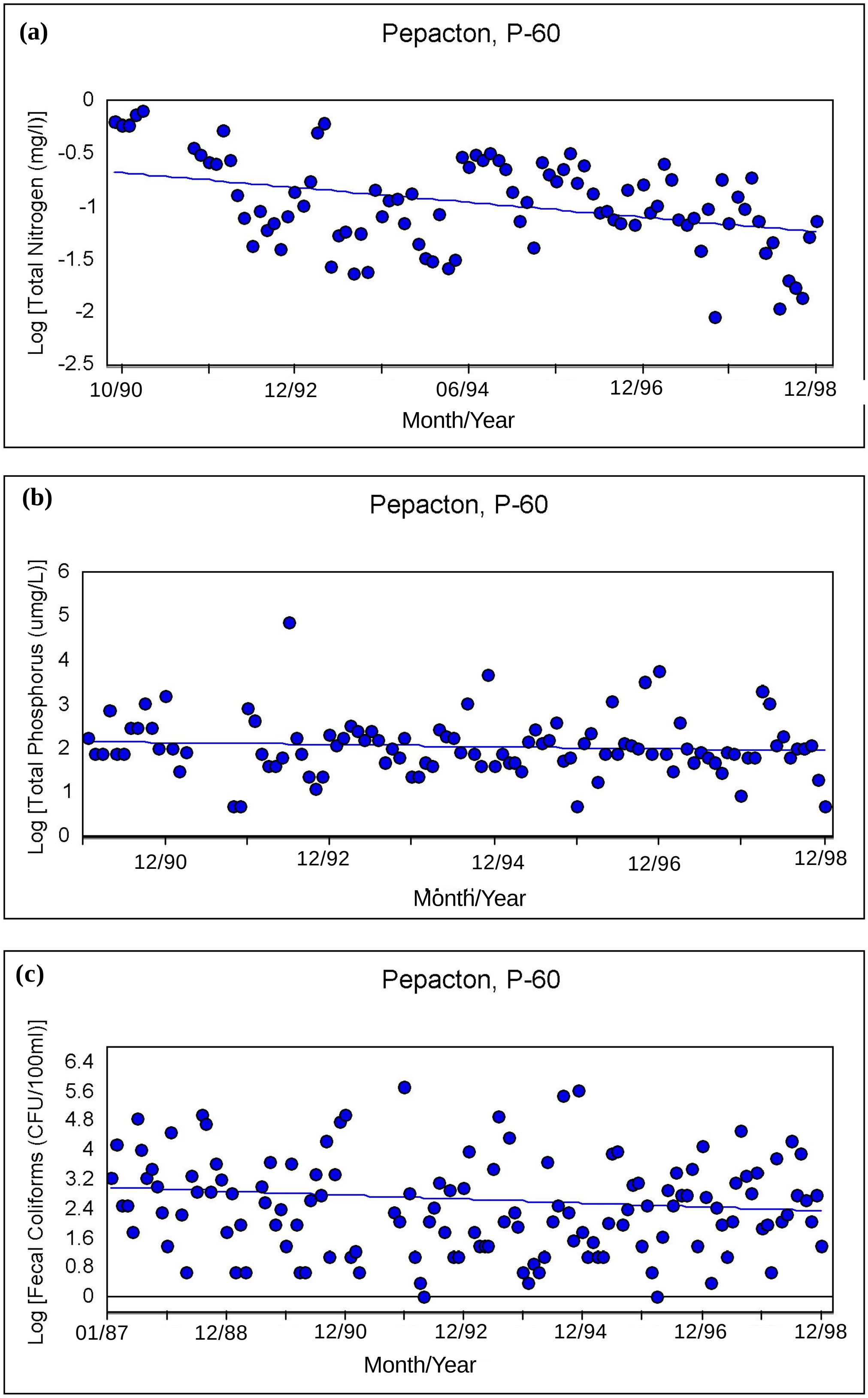


Figure D-8. *Average monthly **(a)** total nitrogen (1990-1998), **(b)** total phosphorus (1990-1998), and **(c)** fecal coliforms (1987-1998) at the Pepacton water quality trend site. The blue line shows the overall trend with time.*

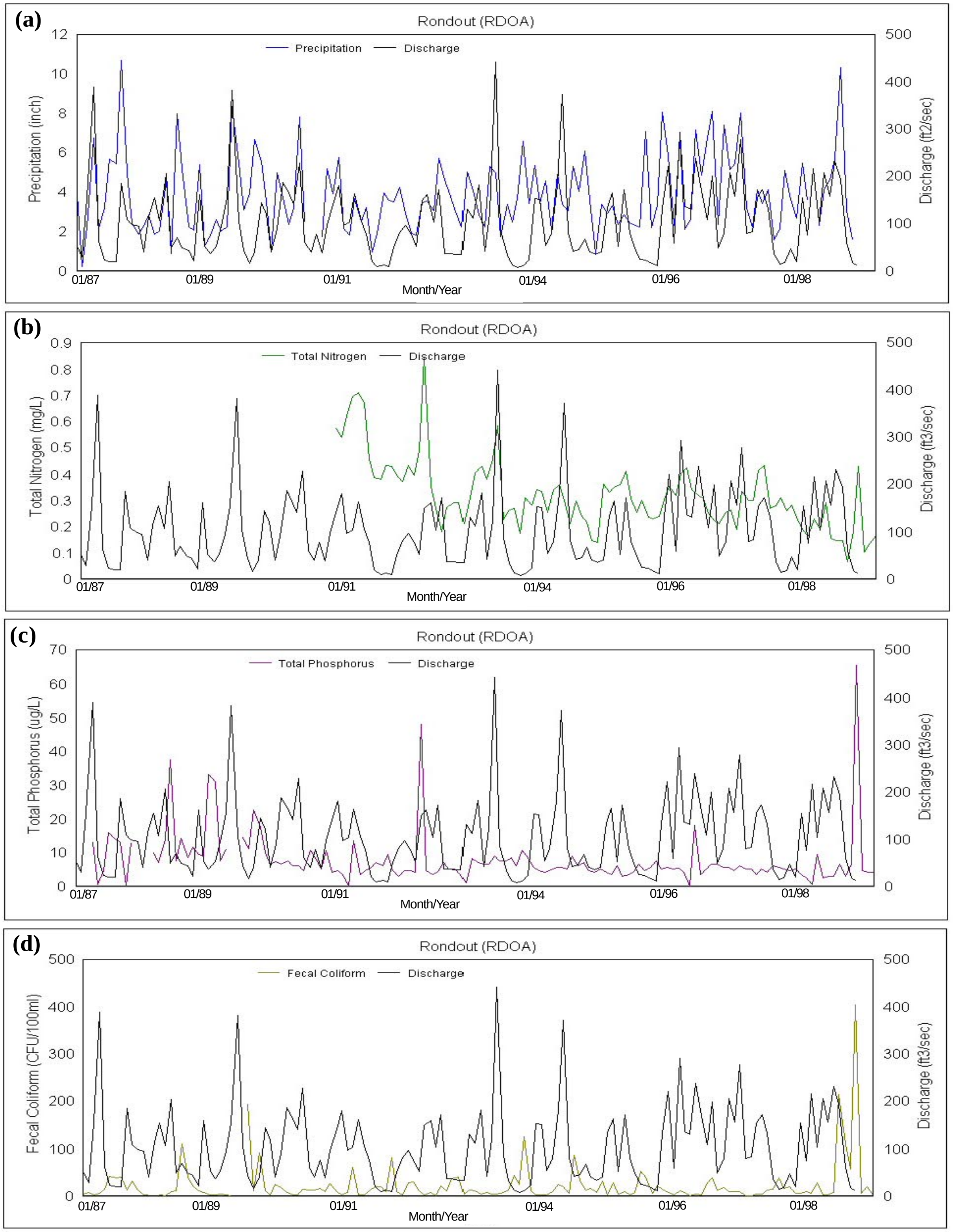
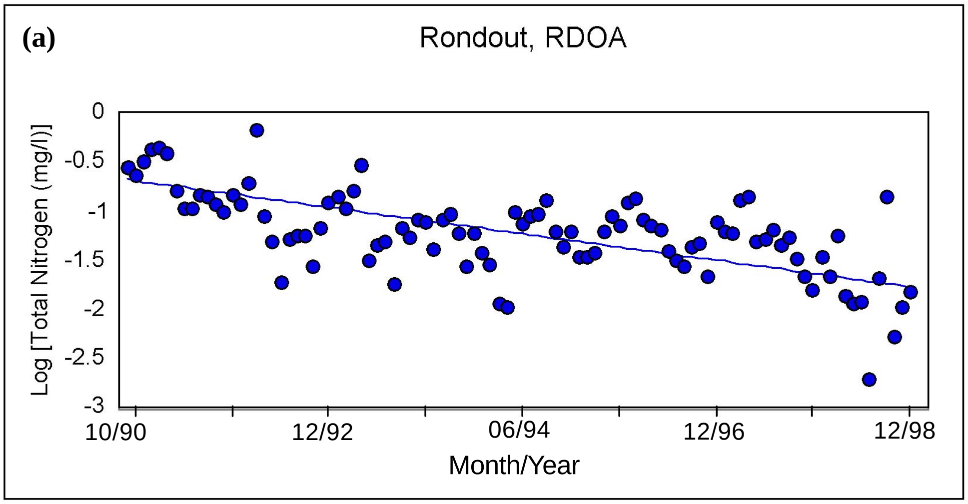
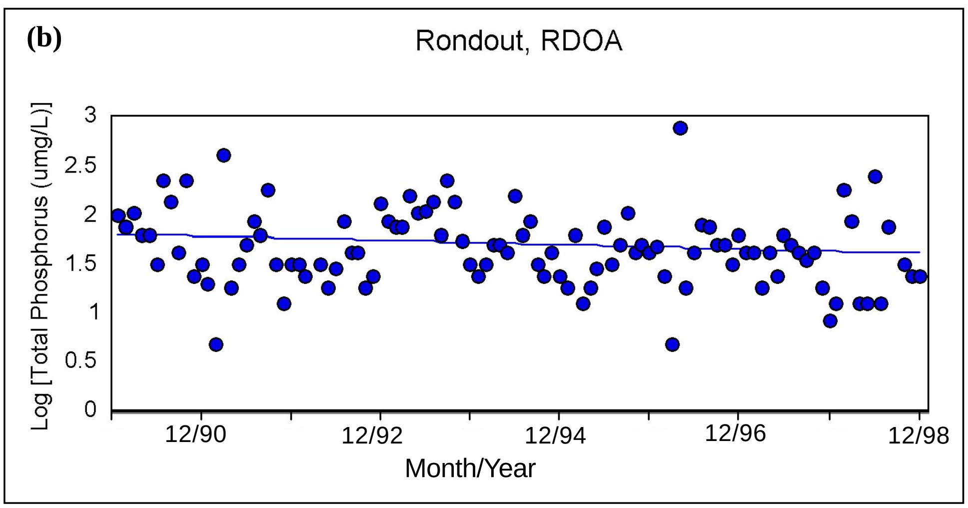


Figure D-9. *Average monthly (1987-1998) discharge and* ***(a)*** *precipitation,* ***(b)*** *total nitrogen,* ***(c)*** *total phosphorus, and* ***(d)*** *fecal coliforms at the Rondout water quality trend sites.*





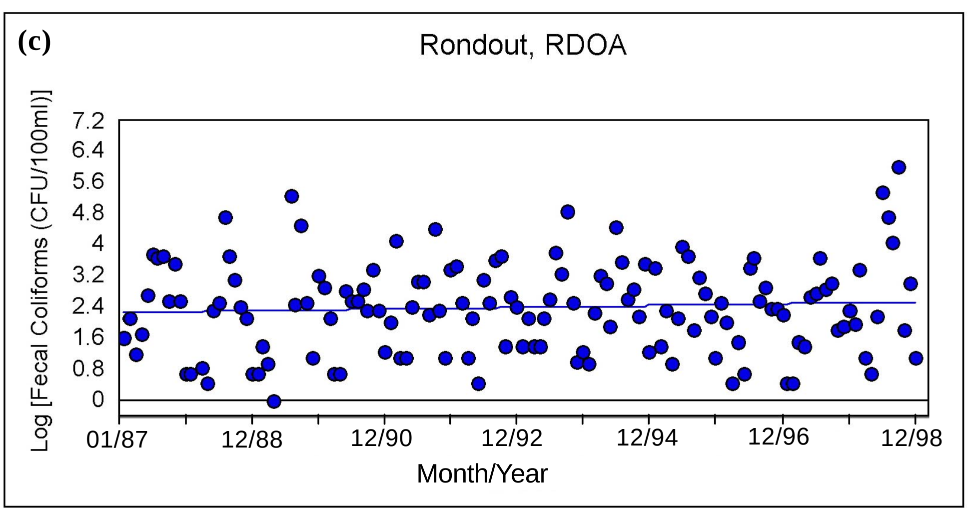


Figure D-10. *Average monthly **(a)** total nitrogen (1990-1998), **(b)** total phosphorus (1990-1998), and **(c)** fecal coliforms (1987-1998) at the Rondout water quality trend site. The blue line shows the overall trend with time.*

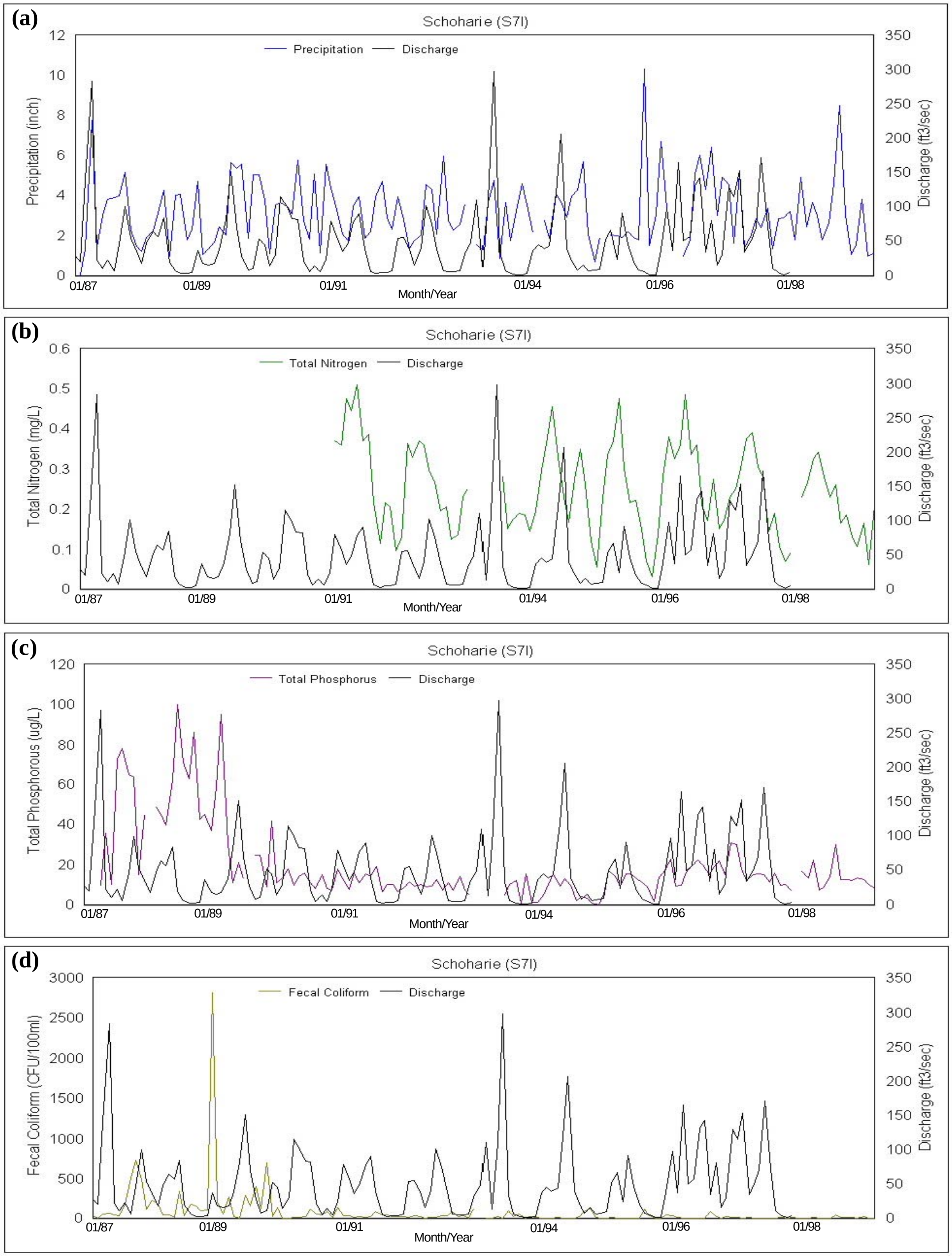
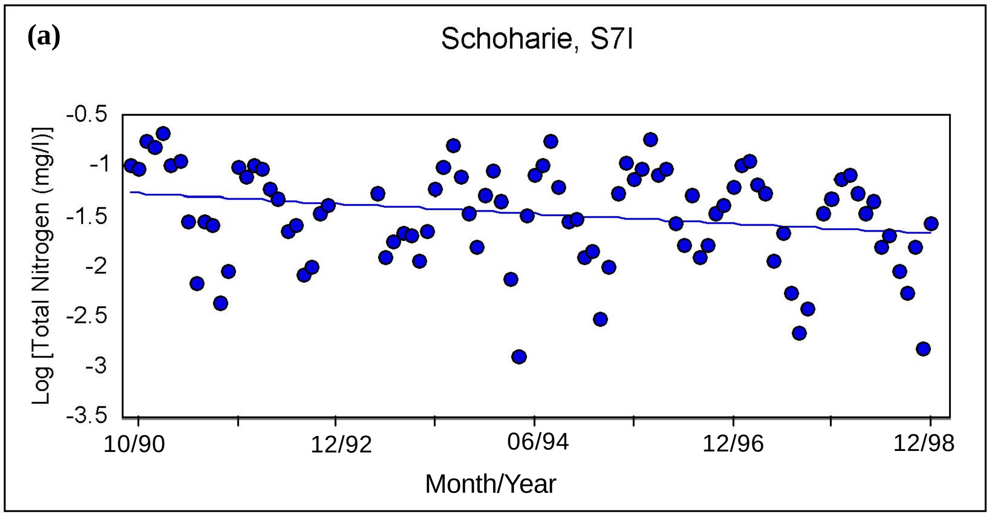
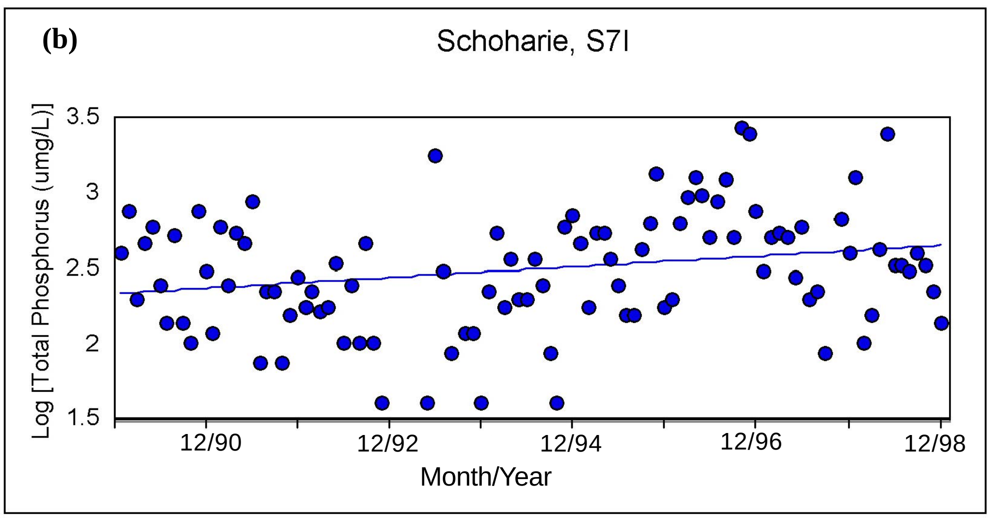


Figure D-11. *Average monthly (1987-1998) discharge and **(a)** precipitation, **(b)** total nitrogen, **(c)** total phosphorus, and **(d)** fecal coliforms at the Schoharie water quality trend sites.*





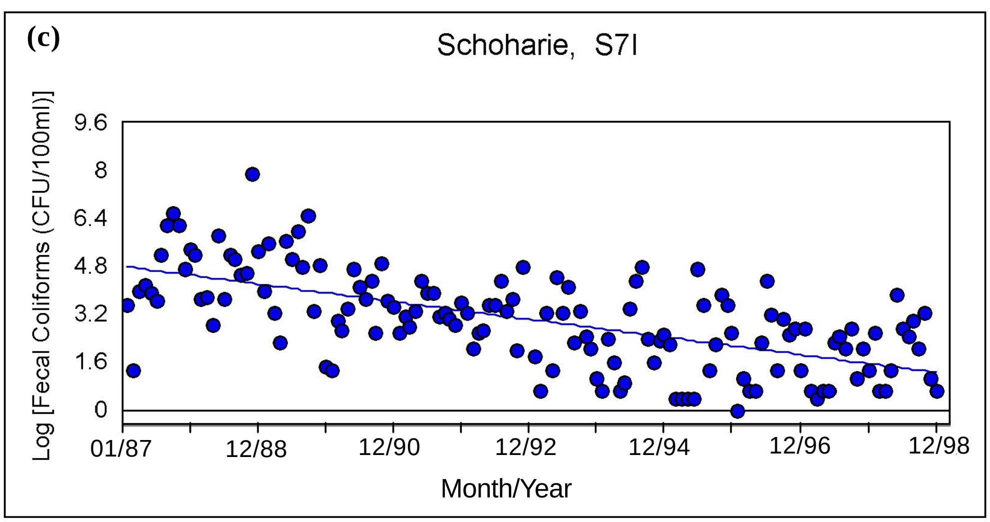


Figure D-12.** Average monthly* **(a)** *total nitrogen (1990-1998),* ***(b) *total phosphorus (1990-1998), and* ***(c)*** *fecal coliforms (1987-1998) at the Schoharie water quality trend site. The blue line shows the overall trend with time.*

Glossary

303D List
List of impaired waters (stream segments, lakes) that the Clean Water Act requires all states to submit for EPA approval every two years.

Acid Rain
A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Ambient
Outdoor.

Anion
A negative ion.

Anthropogenic
Relating to, or resulting from the influence of human beings on nature.

Biophysical
The geology, hydrology, soil, elevation, rainfall, temperature, plants and animals present in an area of study.

Cation
A positive ion.

Cation Exchange Capacity
The maximum number of moles of proton charge dissociable from unit mass given conditions of temperature and pressure.

Correlation Coefficient
A correlation coefficient is a number between -1 and 1 which measures the degree to which two variables are linearly related. If there is perfect linear relationship the correlation coefficient will be 1 or -1. A correlation coefficient of 0 means that there is no linear relationship between the variables.

Deciduous
Falling off or shed seasonally or at a certain stage of development in the life cycle.

Ecosystem
Community of different species interacting with one another and with the chemical and physical factors making up the nonliving environment.

Effluent
Wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Estuaries
Regions of interaction between rivers and near shore ocean waters, where tidal action and river flow create a mixing of fresh and salt water. These areas may include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife.

Eutrophication
A process whereby a water body becomes enriched by increased amounts of nutritive compounds such as nitrogen and phosphorus, resulting in the over production of plant life. Human activities can accelerate the process.

Fallow Fields
Cultivated land that is allowed to lie idle during the growing season; the tilling of land without sowing it for a season.

Fecal Coliform
Bacteria found in the intestinal tracts of mammals. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

Filtration Avoidance Determination (FAD)
A watershed protection agreement to protect the source of New York City's drinking water supply. The City will undertake measures to ensure continued protection of water quality within the watershed without filtration.

Geographic Information System (GIS)
A system, usually computer based for the input, storage, retrieval, analysis and display of interpreted geographic data. The data base is typically composed of map-like spatial representations, often called coverages or layers. These layers may involve a three-dimensional matrix of time, location and attribute or activity. A GIS may include digital line graph (DLG) data, digital elevation models (DEM), geographic names, land-use characterizations, land ownership, land cover, registered satellite and/or aerial photography along with any other associated or derived geographic data.

Glacial Till
Accumulations of unsorted, unstratified mixtures of clay, silt, sand, gravel, and boulders.

HUC
Hydrologic Unit Code, used by the U.S. Geological survey to reference hydrologic accounting units throughout the United States. Can be used interchangeably with watershed.

Human Use Index
The proportion of an area that is urbanized or used for agriculture is a measure of human use known as the U-index.

K-Factor
A measure of erodibility for a standard condition. It represents both the susceptibility of soil to erosion and the rate of runoff in a standard unit plot condition.

Land Cover/Use
Dominant vegetative, water, or urban cover in an area.

Landscape
A conceptual unit for the study of spatial patterns in the physical environment and influence of these patterns on important environmental resources.

Landscape Metrics
Refers to landscape measurements which are used as independent variables in the landscape indicator models to be developed. A landscape metric typically is based on one spatial measure or aspect; examples include population density, human use index, road density, and proportion of watershed with crops on steep slopes.

Median Value
The median is the value halfway through a data set, below and above which there lies an equal number of data values.

MRLC
Multi-Resolution Land Characteristics Consortium is a consortium of federal agencies that pool financial resources in order to acquire satellite-based remote sensor data in a cost effective manner, for their environmental monitoring programs.

Multispectral Scanner (MSS)
The MSS is a nonphotographic imaging system which utilizes an oscillating mirror and fiber optic sensor array. The mirror sweeps from side to side, transmitting incoming energy to a detector array which sequentially outputs brightness values (signal strengths) for successive pixels, one swath at a time. The forward motion of the sensor platform carries the instrument to a position along its path where an adjacent swath can be imaged. The MSS simultaneously senses radiation using an array of six detectors in each of four spectral bands from 0.5 to 1.1 micrometers.

Multiple Regression
The multiple regression is used to find a linear relationship between a response variable and several possible predictor variables.

N-Index
The proportion of an area that is in forest, grassland, wetland, and shrub cover and is a measure of natural vegetation.

NLCD
National Land Cover Data is one of the projects sponsored by the MRLC. The project objective was production of land-cover data for the conterminous United States using Landsat 5 Thematic Mapper (TM) satellite data and production of general land cover classes.

Nonpoint Source Pollution
Pollution sources which are diffuse and do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by storm water runoff. The commonly used categories for nonpoint sources are: agriculture, forestry, urban, mining, construction, dams and channels, land disposal, and saltwater intrusion.

Nutrient
Any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Organics
Referring to or derived from living organisms; in chemistry, any compound containing carbon.

Pathogens
Microorganisms that can cause disease in other organisms or in humans, animals and plants. They may be bacteria, viruses, or parasites and are found in sewage, in runoff from animal farms or rural areas populated with domestic and/or wild animals, and in water used for swimming. Fish and shellfish contaminated by pathogens, or the contaminated water itself, can cause serious illnesses.

pH
The negative common logarithm of free-proton activity.

Pixel
A contraction of the phrase "picture element." The smallest unit of information in an image or raster map. Referred to as a cell in an image or grid.

Point Sources
A stationery location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack.

Pollution
Generally, the presence of matter or energy whose nature, location or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the manmade or man-induced alteration of the physical, biological, and radiological integrity of water.

Regression Analysis
A regression is an algebraic expression of the relationship between two (or more) variables. A regression analysis indicates the extent a prediction or association of response variables can be made using an independent set of predictor variables .

Reservoir
Any natural or artificial holding area used to store, regulate, or control water.

Riparian Buffer Zone
Riparian buffer zones are an arbitrary delineation of the ecotone between terrestrial and aquatic ecosystems.

Riparian Ecosystem
A system located within close proximity to aquatic or subsurface water, having a high water table, distinct vegetation and soil characteristics. Riparian ecosystems are uniquely characterized by the combination of high species diversity, density, and productivity. There is a continuous exchange of energy nutrients and species between the riparian, aquatic, and upland terrestrial ecosystems.

Riparian Zone
The area of vegetation located on the bank of a natural watercourse, such as a river, where the flows of energy, matter, and species are most closely related to water dynamics. The "riparian zone" can specifically refer to the linear corridors associated with streams and streamside vegetation.

Scale
The spatial or temporal dimension over which an object or process can be said to exist. The spatial, attribute, and temporal parameters associated with making an observation or measurement, usually including resolution, extent, window size, classification system (nomenclature), and lag. The way in which objects, parts of objects, or processes are related as the scale of measurement changes. The amount of information or detail about an area.

Sediments
Soil, sand, and minerals washed from land into water usually after rain. They fill in reservoirs, rivers and harbors, destroying fish-nesting areas and holes of water animals, and clouding the water so that needed sunlight might not reach aquatic plants. Farming, mining, and building are activities that expose sediment materials, allowing them to be washed off the land after rainfalls.

Soil Moisture
The percent of the soil volume containing water.

Soil Porosity
The pores (cracks and spaces) in rocks or soil, or the percentage of the rock's or soil's volume not occupied by the rock or soil itself.

Spatial Resolution
The "grain" size of a set of imagery and is dependent on the sensor being used, the structure of the ground area being sensed. The higher the resolution, the more detail captured, the smaller the area covered within a pixel.

Stepwise Regression
A regression where the "best" model is developed in stages using a list of several potential explanatory variables. The variable having the strongest explanatory power is used first, then the second, until no more variables having a significant contribution are left.

Stream Connectivity
The flow of water from headwater drainages to larger watershed streams. The movement of water from one place to another via streams.

Stream Density
The amount of streams per total area of a watershed.

Subwatersheds
The drainage area of off mainstream tributaries, generally including first and second order streams.

Suburbanization
The outward expansion of cities resulting in the conversion of rural land to urban developments, rights-of-way, highways, and airports

Surface Water Runoff
Sheet flow across the landscape that usually occurs during and immediately following rainfall or spring thaw.

Temporal Data
Information or measurements gathered over time.

Terrestrial
Pertaining to land.

Thematic Mapper (TM)
The TM is a nonphotographic imaging system which utilizes an oscillating mirror and seven arrays of detectors which sense electromagnetic radiation in seven different bands. The thematic mapper sensor is a derivative of the multispectral scanner (MSS) generation of scanners, achieving greater ground resolution, spectral separation, geometric fidelity, and radiometric accuracy.

TMDL
Total maximum daily loads. TMDL is a calculation of the amount of pollutant a water body can receive and still meet standards set forth in the Clean Water Act.

Topography
The configuration of a surface including its relief and the position of its natural and manmade features.

U-Index
The proportion of an area that is urbanized or used for agriculture and is a measure of human use.

Urban Development
Rate of growth of an urban center.

Water Holding Capacity
The point at which a soil becomes saturated with water and ready downward drainage will occur with the addition of more water.

Water Quality Standards
Specific standards for water condition which, if reached, are expected to render a body of water suitable for its designated use. The criteria are based on the level of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Watershed
A watershed is a natural unit of land that captures rainfall, snow or other forms of precipitation, which then drain or infiltrate to streams and ground water.

Watershed Pollution Potential
The amount of pollution predicted to enter stream water as a result of landscape proportions within a watershed. The potential is predicted based on a set of metrics known to significantly contribute water quality.

Wetland
An area of land located at the junction of upland terrestrial and aquatic ecosystems having water present at the surface or within the root zone, anoxic soils, and hydrophytic plants.

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